TWENTIETH ANNUAL MOTOR NUMBER

SCIENTIFIC AMERICAN

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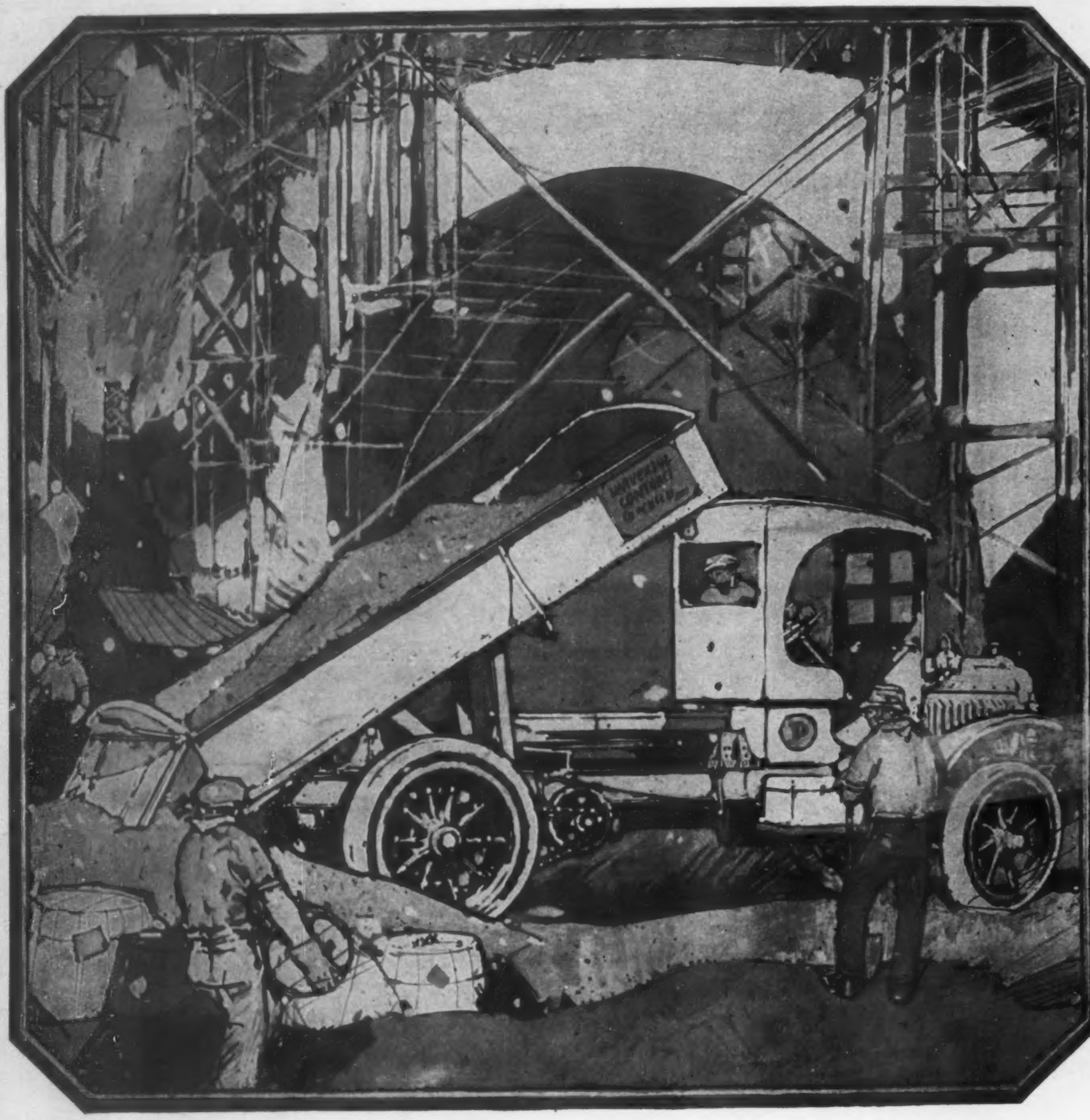

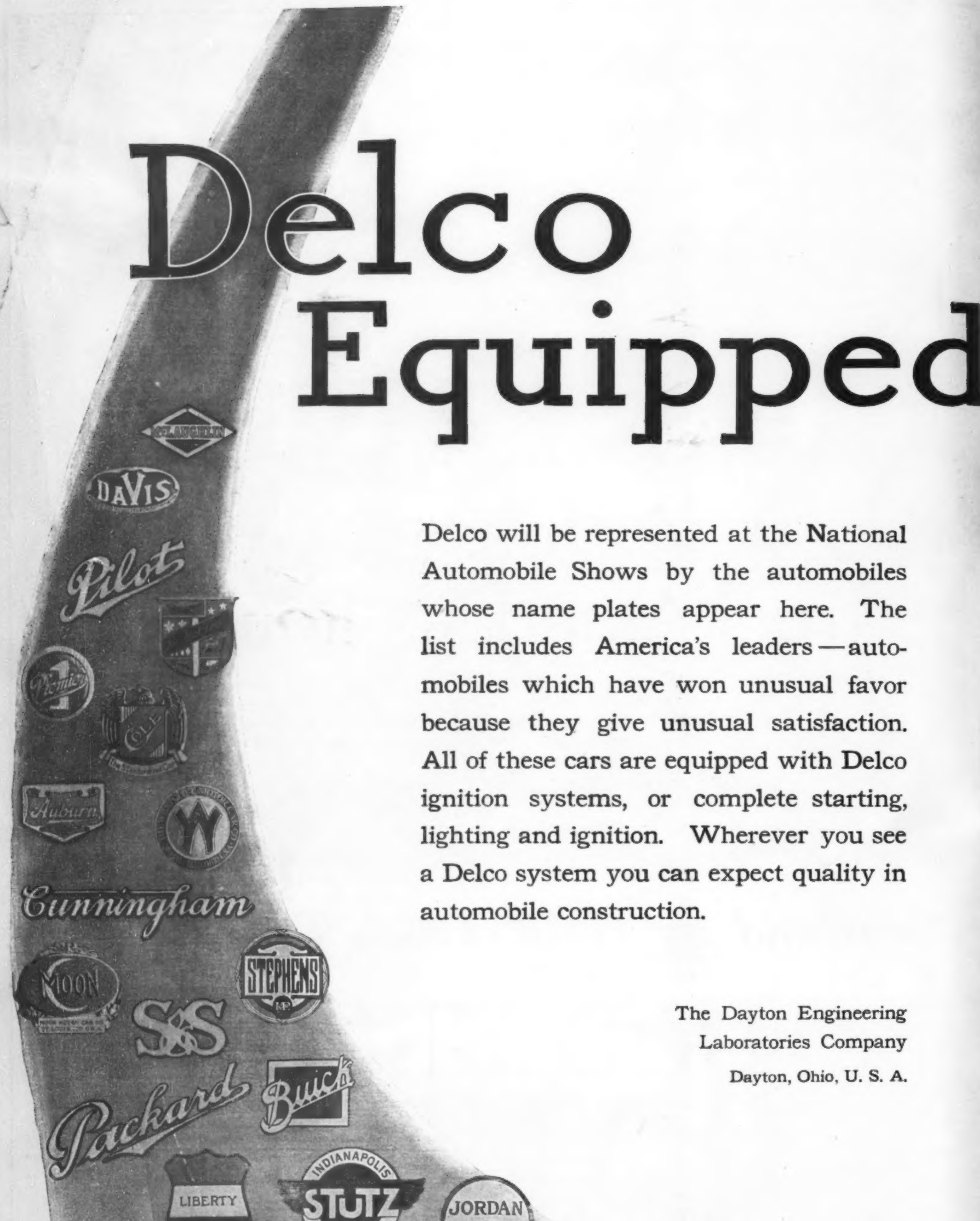
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SEVENTY-FOURTH YEAR

SCIENTIFIC AMERICAN

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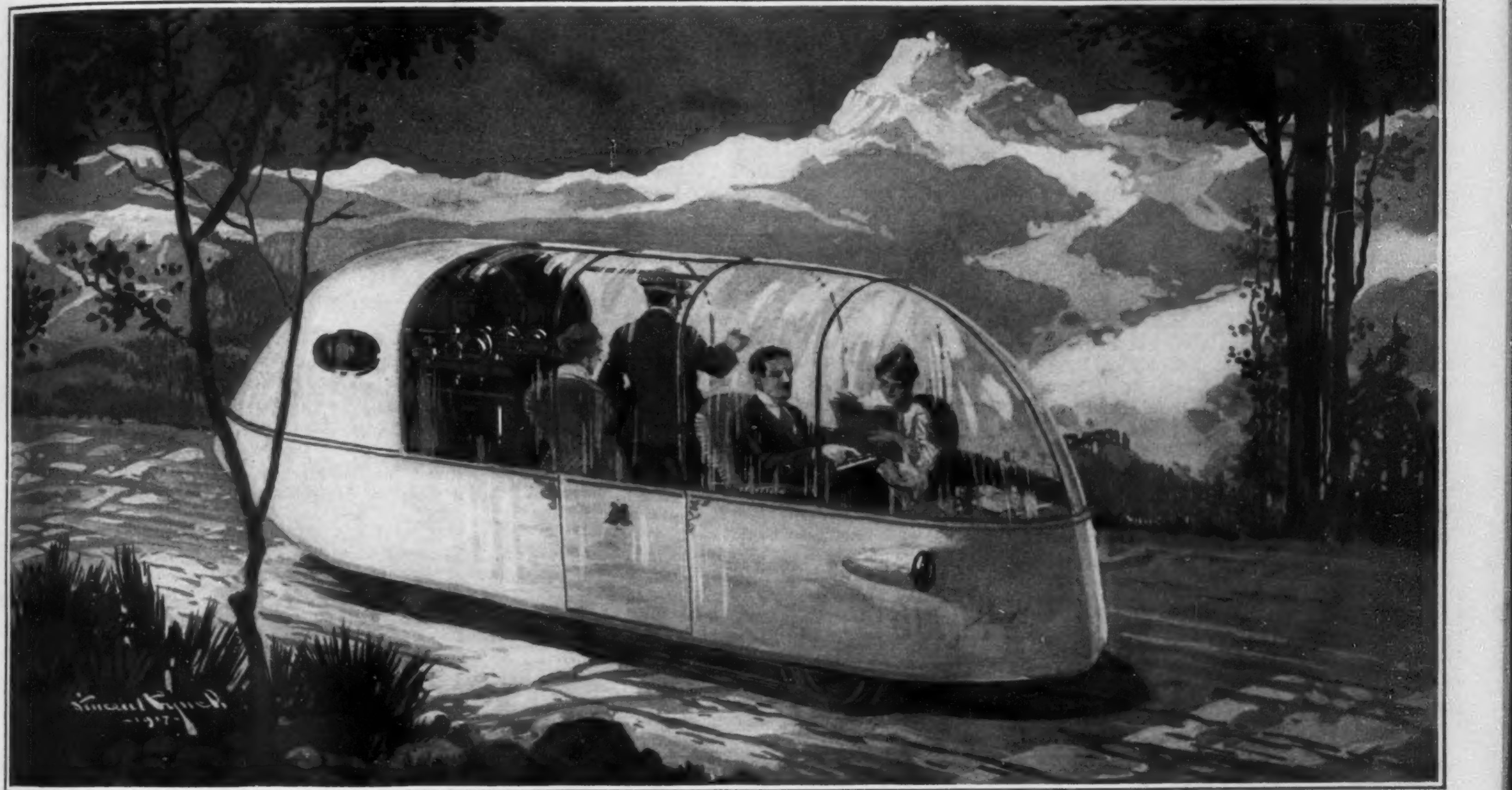

The motorist's dream: a car that is controlled by a set of push buttons

The Motor Car of the Future

By C. H. Claudy

"OH yes," you say, as you look at the title "some one is dreaming over a welsh rabbit, and writing it down—no one knows anything about the motor car of the future!"

It's more or less true—no one really *knows* anything about the future. But the future can often be predicted from the present, nevertheless. If you jump off a twenty-story building, I'll bet you on my prediction of what is going to happen to you when you bring up. If you see two railroad trains approaching each other on the same track at sixty an hour, you will bet on your prediction that there'll be splinters in a minute. And any one who considers the development of the automobile in the past can make a guess as good as yours or mine as to what it is going to be next year.

And if next year, why not in the next ten or twenty-five or hundred years?

So here goes, for a try.

The automobile of the future will be weather-tight. The open car, the so-called "touring model" will never be as popular in the future as it has been in the past. Of course there will always be as many, if not more body models in the future as now, but they will all tend towards one standard, just as most of the models today tend towards the standard touring, roadster or limousine bodies. And this standard model will be a weather-proof affair. Probably it will be all glass-sides, front, rear *and roof*. The entire trend of the industry runs from clumsiness to refinement, and the present styles of bodies, modeled from long practice on the precedents of hundreds of years of coach building, are far too clumsy to live.

The glass sides will come down, of course, for warm weather. Curtains inside will keep out glare, and a roof curtain will keep off sun when shade is wanted. But frames, instead of being of heavy wood or metal, will approximate the framing now used on the most modern glass show cases. If malleable glass is ever made, the frame may be dispensed with, but this story cannot well go into the possibilities of such a development—nobody *has* discovered malleable glass, to date!

The power plant of the car of the not-too-near future will be under the body and on or near the rear axle.

Now, wait a minute! A thousand gasoline engineers are about to arise and call me wicked names, and tell me it can't be done. I dare say it can't—with a gasoline engine. *But who said the car of the future had to have a gasoline engine?*

There is at least one brand new development in the steam-car field, which does this very thing—puts the power plant where it belongs, close to the rear axle, thus dispensing with the long shaft, the universals and their likelihood of breaking and wearing out, and their power loss. Electric automobiles of the present all have their power plants on or near the point of power application. One truck, which drives from all four wheels, and at least one front drive pleasure car, show that some engineers appreciate the real mechanical need of putting the source of power and the place where the power is applied as close together, not as far apart, as possible.

If, as seems reasonable to suppose, the greatest of all power problems is finally solved—if we ever learn to develop the power in gasoline, alcohol, kerosene, explosives, coal—wherever latent power is—*directly* into electricity, then there can be no question as to where the power plant will be. And—make no mistake about it—that development *will one day be made*. To get electricity from coal now we have to burn it, and turn it into heat, use the heat to make water vapor, which has mechanical movement, use the mechanical movement of the steam to drive a turbine or a piston and the resulting rotation to turn a generator—after which we take out about *ten per cent electrical energy for every hundred per cent* in the coal. We do better with gasoline, because we turn it directly into mechanical power in the cylinders of our cars. Some day we'll turn it directly into electrical energy—and the perfect motor will arrive.

But here are other possibilities besides electricity. Kerosene, alcohol, crude oil, some unknown fuel—any or all may be developed in the future as rapidly as the internal combustion engine of today has grown. No man can say, because no man knows, but surely the possibility is more probable to us, today, than the facts of today were probable to us twenty years ago!

However:

Conceding all this, or rejecting it as you will, the fact remains that whether the gasoline engine persists and stays under the hood, or a new engine is developed which moves back to the rear axle, the means of control of a motor are undergoing a revolution right now—and the end is far to seek.

The first automobile had an engine to pull the car, a man to start the engine, a man to stop the car, a man to pump the gasoline, a man to turn down the oiler, a man to pump the tires, a man to fill the oil lamps, a man to light them—Oh, it was the same man, but the point is the engine didn't do anything but pull him around. *He* had to attend to all the rest of it himself.

Today the engine supplies power for lights, power to start itself, power to pump up tires, power to pump its own oil, power to pump its own gasoline.

What is next? Power to stop itself, of course! And here we are on solid ground, for the vacuum brake, which uses engine power to create suction and air pressure to apply brakes, is already on the market. So is an electrical brake, which uses the stored engine energy in the battery to wind a cable on a drum and puts so much pressure on the brake bands that the best practice is to *keep them thoroughly oiled!*

The car of the future won't leave *anything* to be done by man power. In two or three years foot brakes will be things of the past except on cheap cars. *Why* should a man exert *muscle* to stop a car any more than to *start*

(Concluded on page 28)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Retrospect of the Year 1917

The World War

IT is probable that, when the history of the war comes to be written, the year 1917 will be named the most dramatic of the world war—unless indeed the opening year of the war be so designated. It was the year in which the Allies demonstrated everywhere that they were the masters of the situation, possessing a superiority in men, guns, shells and supplies, which promised soon to become overwhelming. The French Army was larger in numbers, finer in morale, and more fully equipped than at any time in the war. The same may be said of the British Army; and Lloyd George, at the close of the year stated in the House of Commons that, in the early months of 1917 the Russian Army was in better shape than at any previous period. Not only was Italy holding the Austrians, but she was actually forcing them back in a series of offensives which, for courage and persistance, have never been surpassed on any front. So completely was Germany on the defensive that the French and British were able to crush in her line and take prisoners by the thousands and many guns, apparently whenever they thought fit to do so. So precarious was the situation in the west early in the year that Hindenburg was forced to withdraw on the Somme front, give up some ten miles of territory, and take refuge in a prepared line of great defensive strength.

The first of the dramatic happenings of the war was that startling tragedy, the Russian revolution. Had there been in that country a man or a body of men who combined with their undoubted patriotism the necessary genius for leadership, the revolution would have been a powerful stroke for the Allied cause. Instead of that, Russia was invaded by a body of interested agitators, pro-German or pro-anarchy, who, working upon the minds of an ignorant and too trustful people, have succeeded in changing that great country from a compact nation into a disorganized mob. The German autocrats, from the Kaiser down, have been quick to seize the opportunity, and, at the present writing, there is being enacted the supreme farce of formal negotiations for peace between the sham representatives of the bitterest enemies that autocracy ever had—the Russian people, and the accredited representatives of the most cruel and unprincipled autocracy in all history. What the issue may be, none can tell——it is in the lap of the gods.

The collapse of Russia has enabled the Teutons to throw their whole strength against the western line. The first result of this was seen in the collapse of the Italian Armies and their retreat to the Piave River, where the issue of battle is yet in the balance. If the Italians, reinforced by the French and British, can hold for a few days longer, the winter's snows will slow up the German-Austrian offensive for the winter.

There is a consensus of opinion, well founded, that the early months of 1918 will witness a supreme and final effort of Germany to win a military decision. In numbers, the opposing armies are perhaps about equal, thanks to reinforcements from the Russian front. In guns and munitionment, the Allies still have probably a slight preponderance. In aircraft, the numbers are also approximately equal. But when we come to the all-important question of morale, there is no doubt whatever that the advantage lies with the Allied forces; for, as we have said, the French and British during the past year have won whenever they chose to attack. The Allied power of munitionment is undoubtedly greater than that of Germany, and their resources in money and materials are greater. At the Battle of the Marne, the French had 1,500,000 men at the front; today they have 2,750,000 men. The British today have some 2,000 000 and possibly more, on the western front. Against these, Germany, as we showed in a recent article, can oppose about 4,500,000 fighting men. It is doubtful if the Germans, in spite of the defection of Russia, can break through; and without our aid the war would have dragged itself along for many a year to come.

The absolute certainty of German defeat is found in the other great dramatic happening of the year—namely, the entrance of the United States into the war, on April 6, 1917. Nobody knew better than Germany that, should it become possible for this country to apply its strength on the European battlefield, her defeat was certain. But they knew that the weak link in any military operations on the part of the United States was the stretch of 3,000 miles of the western ocean, and they firmly believed that if they threw off the last restraints of civilization and inaugurated a ruthless submarine warfare against all shipping, they could at once prevent the transportation of troops to Europe and starve the Allies into surrender. Hence the savagery of unrestricted submarine warfare. We have no time in this review to go into the details of that struggle. Suffice it to say that in the first rush of their attack merchant ships were sunk at a rate which, if it could have been maintained, would have shut us out of the war and destroyed every hope of an Allied victory. But Great Britain, France, Italy and the United States, by bending every effort to the problem, have so far mastered the submarine, that from a weekly sinking of 55 ships the toll taken by the German submarine has sunk to an average of ten or twelve ships; and in the meantime from forty to fifty per cent of the German submarines have been sunk or captured. The United States and Great Britain, moreover, have embarked upon large shipbuilding programs, which, within a few months' time, will be launching new ships faster than the U-boats are sinking them, and by the end of the year will be gaining at an ever-accelerating rate.

So, in the last great gamble for victory, the Germans have lost. They find themselves today confronted by a young, ambitious, highly intelligent and profoundly patriotic people, who, if they were to mobilize their manhood on the 15 per cent German basis, could ultimately call some fifteen million men to the colors. That will never be necessary. Already we have a considerable force at the front. It is growing steadily, and in spite of initial delays, the necessary artillery and other equipment ultimately will be provided at an ever-increasing rate. Some time during the coming year we shall be prepared to strike a telling blow, and, if the final decision does not come in 1918, we have every reason to look for it in the year following. But a peace by victory can be won only if we exert ourselves to the very limit. We should mobilize every able-bodied citizen, if not for the Army at the front, at least for the Army back of the front and within the nation at home. We should mobilize every factory that can turn a wheel to give our Armies a superabundance of all that goes to make up a fighting force. We should mobilize every usable acre of ground for raising the food which is so greatly needed by our dauntless Allies. *We should conscript labor at once; so that for a reasonable wage it will render its full 100 per cent of efficiency.* And finally and above all, we should mobilize the heart and conscience of the nation until it shall look upon this war for the thing that it is—a great world crusade for the redemption from the hands of the Infidel of all those fair ideals of honor, justice, freedom and human coöperation and forbearance, which are at once the foundation and inspiration of our national life and the promise of that great, good world which is to be.

Naval

The response of the Navy to the demands of the war has been both swift and far-sighted; and from the very first the Department has realized the necessity for the most complete coöperation with our Allies. The presence of Vice Admiral Sims and his staff in London, where he is in command of the joint British and American operations covering the Atlantic approaches to the Allied ports, is evidence of this. Furthermore, the Department has directed its main effort in new construction to the building and equipping of those ships which have been found to be most effective for anti-submarine warfare. Already we have sent the pick of our destroyer fleet to the other side, to say nothing of flotillas of the new submarine chasers—and these are merely an earnest of many more to follow. A large destroyer program is under way, and work on this has been so speeded up, that the boats will be in commission in less than a year from the laying of the keels. The new destroyers are even larger and more powerfully armed than our new 1,100-ton boats.

The close of the year finds the submarine situation well in hand. Not only have the sinkings been reduced in the past nine months from a maximum of 55 ships per week in April to an average of ten or twelve ships in December, but between forty and fifty per cent of the German submarines have been sunk or captured.

The Allies, throughout the submarine campaign have learned war by making war; and as the outcome of the vast amount of thought, experimentation and experience, ashore and afloat, it has been found that the most effective offensive-defensive warfare consists in the convoying of merchantships in assembled fleets by a powerful cordon of heavily-armed destroyers provided with the depth bomb—the merchantships themselves being armed with guns, preferably of from five- to six-inch caliber. Coupled with this is the anchored mine field, judiciously disposed to block the exit from the enemy's submarine bases—this last, an offensive measure of which the British have made extensive use, and to which, during the coming year, the efforts of the Allied fleets will, we hope, be applied with great intensity.

Nothing may be said at this time about the progress of construction of the powerful additions to our main fleet which were authorized before we entered the war. It includes five superdreadnoughts of 32,000 tons, mounting twelve, 14-inch guns; four ships of 32,500 tons, carrying eight, 16-inch, 45-caliber guns; and four super-noughts, the biggest yet planned for any navy, of over 40,000 tons, mounting twelve, 16-inch, 50-caliber guns. In addition, the program includes six, 35,000-ton, 35-knot battle-cruisers, and ten, 7,500-ton, 35-knot scouts.

We are much pleased to be able to state that largely as the result of the agitation by the SCIENTIFIC AMERICAN for a reconsideration of the plans for the motive power of the battle-cruisers, these plans have been recast so as to bring the whole of the boiler plant below the water-line. It has been found possible to do this, moreover, without adding to the length or displacement of the ships.

The expansion of the Navy in general has been truly enormous. The total strength of the personnel, including the Marine Corps, on November 15th, 1917, was 272,-000 officers and men, and it is still growing. So far as material is concerned, the total number of vessels of all kinds has been trebled since the war began, the total number of ships now under construction being close upon 800, including every type from the submarine chaser to the superdreadnought. For the fuller details of the expansion of our Navy reference is made to our Liberty War Number of December 1st, 1917.

Military

We could wish that the response of the War Department to the call of the President had been as immediate and far sighted and uniformly efficient as that of the Navy Department; but unfortunately the dilatoriness displayed by the Bureau of Ordnance, and to a lesser extent by the Quartermaster Department, has spoiled a record of achievement which, otherwise, would have been most commendable.

Nothing finer was ever done in the way of vast constructive operations than the building of our 16 cantonments for the housing of the 650,000 men which were to be secured from the first draft. It was a masterpiece of intelligent coöperation by men thoroughly qualified for their work.

Most inspiring has been the way in which the youth of the country, with few exceptions, have accepted the draft and entered into the preparatory training at the camps. There is every indication, so far as the men themselves are concerned, that they will be ready at the time originally set for their departure to the battlefields. That we shall not be able to put these men in the front line as early as the nation expected is due, in large part, to the lack of a comprehensive, executive grasp of the situation in the Bureau of Ordnance, which seems to have completely lost sight of the fact that time is the very essence of the contract. The same thing is true in a lesser degree of the Quartermaster Department. The feeling of dismay and disappointment throughout the country is making itself felt, and will increasingly make itself felt, in a demand that some military man of proved farsightedness and executive ability be called to Washington to fill the position of Chief of Staff. Such a man undoubtedly can be found among the high ranking officers of our Army. As Chief of Staff he should be given a free hand, untrammeled by the inertia or red tape which has proved the undoing of at least two of the great Army bureaus.

The last year has shown, more than ever, that the war is a war of the machine gun and the howitzer, and instead of fooling around trying to select weapons which will have the distinction of being invented by ourselves, and of being something-per-cent better than the proved weapons of efficiency of our Allies, we ought to select the best type in existence today, and mobilize our factories for its manufacture on an altogether unprecedented scale. Every day of time lost in our preparations means the sacrifice of precious human lives, and every month lost may mean a disaster of the first magnitute to our Allies.

The struggle along the western front has developed nothing strikingly novel in the way of military tactics, unless, indeed, it be the unique "German victory" proclaimed by von Hindenburg, when, to save himself from disaster, he made a great retreat from the Somme front to the so-called impregnable Hindenburg line. This line, by the way, in the closing days of the year, was pierced and held on a ten-mile front by a combined tank-and-infantry attack opposite Cambrai. Also, there was something novel in the German modification of their system of defense, by abandoning the strongly held front trench line for a thinly held front line supported by a zone of numerous scattered fortified positions (pill boxes) and heavy masses of men held in reserve back of this zone for

the counter attack. The British artillery has mastered this so-called elastic defense as effectually as it did the old trench line and deep dugout system.

Both the French and British armies have fought their way, during the year, to the top of the dominating positions lying between Rheims and the English Channel. Today they hold the crest of the ridges, and have the terrain occupied by the German armies under direct observation and subject to superior gun fire.

The tank, after a temporary eclipse, came into its own again at Cambrai, and we understand that a large number of these, bigger, more strongly armed, and better protected, will appear on the western front when the spring offensive opens. We have been asked why the Germans do not build tanks. The answer is that the tank is essentially a weapon of offense, and Germany, having been thrown on the defensive, has no use for these weapons.

At the present writing, the Italian Army, with French and British assistance, is engaged in a defensive fight against the attempt of the Teutons to break through into the Plains of Lombardy back of the Piave River. The issue of this great battle is uncertain.

The months which must elapse before the American Army reaches the front in sufficient force seriously to affect the situation will witness the most critical and fierce fighting of the whole war; for unquestionably Germany will make a last supreme effort to regain the initiative and break through the western front. It is our belief that though she may bend, she will fail to break, that line of seasoned French and British veterans, backed by massed artillery, and flushed with ever-recurring victory, which stretches from the North Sea to the Swiss border.

Engineering

The mobilization of all forms of activity for the purposes of war has naturally slowed down the great works of engineering, which usually bulk so big in a review of the progress of the year. Two of the most notable works to be completed are Canadian enterprises, namely, that fine structure, the Quebec Bridge, and the great system of docks at Halifax. On September 16th, the 5,000-ton suspended span of the Quebec Bridge was successfully lifted into place, thus completing the largest cantilever span in existence. Its length of 1,800 feet may be compared with the next longest spans, the two cantilevers each 1,710 feet in length of the Forth Bridge Scotland. With these great bridges may be compared the three famous suspension bridges across the East River, New York: the old Brooklyn Bridge of 1,595 feet span, the Manhattan Bridge of 1,475 feet span, and the Williamsburg Bridge of 1,600 feet span.

The new Halifax docks have been built for the Canadian Government, at a cost of $30,000,000, by American contractors. They were begun in 1914, and are now practically completed. They are built of reinforced concrete, and their capacity may be judged from the fact that fifty vessels of 7,500 tons can be accommodated at the same time. The Catskill water supply, the greatest municipal undertaking of its kind, was completed in the fall of this year. The water is led from the Ashokan Reservoir, of 132,000,000,000 gallons capacity, to New York by means of an aqueduct 120 miles in length, through which an entirely new supply of 500,000,000 gallons daily is made available for Greater New York. The work of completing the New York State Barge Canal, which extends from the Great Lakes to tide water of the Hudson River at Albany, has been pushed through with considerable vigor during the past year, and there is every prospect that it will be opened for service by May of 1918.

Electricity

Whatever startling developments have taken place during the eventful year of 1917 are hidden behind the veil of the censor, and it remains for us to wait for the end of the war before a complete review can be undertaken. For it is certain that progress has been made in many directions, such as new methods of producing nitrogen from the air, new electro-chemical processes in general, more efficient wireless apparatus, and so on.

Among the known developments have been those in electric railroading, an ingenious form of magnetic gear which is suitable for use with steam turbines, and a highly ingenious system of recording sound waves on a motion-picture film by means of a string galvanometer and a selenium cell. The arc light has been gradually replaced by a high-power filament lamp in the motion-picture projector, stereopticon, and spot light. Flood-lighting has come into its own in a big way, especially since America's entry into the war, playing an important part in the guarding of bridges, plants, arsenals and other structures or establishments.

Aeronautics

With the close of 1917 it has more than ever become apparent that aviation, for the time being at least, is developing along strictly military lines. Of all the wonderful progress that has been made during three and a half years of war, there is bound to be much of commercial value after the war. For one thing, the huge bombing machines developed by the Allies and Germans have immediate commercial possibilities, while the wonderful engines born of the insistent demand of military aviation for reliable power plants are a permanent contribution to the art, whether in peace or in war.

The past twelve months have been fruitful for aviation. Fighting machines have been steadily improved in maneuvering ability and armament. The crude arrangement of machine guns which persisted even in 1916 has been replaced by twin guns firing through the propeller in the latest fighting machines of both sides, and for the most part the two-seater fighters have been abandoned. It is difficult to say just how far the speed of fighting planes has been increased, but it appears to have been raised to close on to 150 miles an hour in the scouts of small wing spread, burdened with an engine of 200 horse-power or more. By mounting the machine guns in front of the tractor type planes, the accuracy of aerial fire has been materially enhanced. The so-called "dead angle" or "blind spot" has been steadily decreased in size, until the Gotha bombing planes of the Germans with their machine-gun tunnel under the fuselage, eliminate the last "blind" area under the tail.

Good use has been made of the airplane as an offensive weapon. The Germans and the Allies have developed huge machines during the past year. The former brought out the Gotha biplane which they employed in place of Zeppelins in bombarding England. Meanwhile the Allies turned out the Handley-Page biplanes carrying a crew of four men with three guns and a ton and a half of bombs, as well as the Caproni triplanes which carry three tons of bombs. Raids have been made far into the enemy's country by both sides, and this activity in all probabilities is to be extended during 1918. Indeed, aerial raids have begun to take on the form of long-range artillery bombardment.

Although the Zeppelin type appeared to be waning as far as the German aerial raids are concerned, the past twelve months have witnessed a growing interest in the dirigibles. The Allies in particular have been using more and more dirigibles for submarine patrol work, and the Italians have developed the Forlanini type to a high state of efficiency, enabling great altitudes to be attained as well as permitting of remarkable stability on long-distance flights. It seems that the advantages of the lighter-than-air are slowly being appreciated.

With the entrance of the United States into the world war there was inaugurated a gigantic air service, calling for the training of thousands of men and the construction of tens of thousands of machines. With characteristic American enterprise the Government and the industries of the country set to work on the huge task of making up in less than one year what our Allies and enemy gained in years of peace and war. The close of the year saw the aerial program well under way; but it remains for the present year to reveal the power of our full-grown Eagle in the skies of France and Germany.

Sciences

During the year a vast amount of progress has been made alike by the theorists and the exponents of practical application, and as usual, these two schools have been found not so far apart as they have thought themselves to be. Much of what has been accomplished, however, is connected directly or indirectly with the prosecution of the war or the attainment of the necessary degree of wartime industrial efficiency. Of these items many are such that even a hint of their nature were unwise; so until the coming of peace dispels the danger of "giving aid and comfort to the enemy," it must be understood that any catalog of scientific activities has been severely expurgated.

With this reservation, we must award the palm for work done and revealed during the year to the scientists who have been investigating the phenomena of the earth's crust. In Hawaii, in Tuscany and in Salvador a good deal of light has been shed upon the dynamics of the earth, as revealed by volcanoes and earthquakes. The statics of the shell of matter on which we live have likewise been put on a better basis by the work done in the United States, by Federal investigators, in support of the isostasy hypothesis—which asserts that at some depth beneath the surface there exists a level at which equal areas support equal pressures from above. In New South Wales the strains of the earth's crust due to the rather unusual load imposed by a new reservoir holding thirty billion gallons of water have been investigated. The instruments here employed have recorded earth-tides, earthquakes, and fault movements with accuracy; and in addition there have been shown deflections which appear to be identified with the action of the water load.

In this same class must be put two investigations having to do with gravity. Last year we mentioned on this page the discovery of T. E. Shaw that the gravitational constant is variable under application of heat. The notion of gravity as fixed and immutable is still further prejudiced by the announcement that Prof. F. E. Nipher has succeeded, under appropriate conditions of electrification, not only in reducing and increasing the gravitational pull between small bodies, but actually in converting it into a negative repulsion force. At the same time we are informed from another source that comparison between the mercurial barometer, which is affected by gravity, and the aneroid, which is not, shows a decrease in gravity pull over the deep bed of the Indian Ocean—a result which has distinct bearing upon the validity of the isostasy hypothesis, mentioned above.

In experimental and industrial science the tendency remains toward the infinitesimal. Our Bureau of Standards and our private workers continue to produce testing instruments for mulitudinous uses, giving readings to an ever increasing degree of fineness. The Cottrell apparatus for precipitation has been used more successfully than before for the dissipation of fogs and other purely gaseous and liquid vapors. Prof. Korn, the German inventor of "photographs by wire," has succeeded in so modifying his sending and receiving technique that his processes are now available with submarine cables; and it is predicted that a transatlantic photographic service by cable will be one of the first things to follow in the wake of peace.

In the domain of the non-mathematical sciences, perhaps the most interesting of the year's announcements is that concerning the revegetation of a small island in Salton Sea. At the height of water in 1907 this bit of land was so thoroughly washed over by salt water that all vegetation was killed and all seeds sterilized. Since then something like 500 species have appeared through the ordinary processes of nature, and under the very careful observation of Dr. T. T. MacDougall of the Carnegie Institution. These processes include transportation by wind and water, but apparently not by birds. It has also appeared that certain seedlings may float about for a time and take root when stranded—a possibility heretofore overlooked. The complete report of these observations throws a great deal of light upon the whole subject of plant dissemination.

In the geographic field we have to chronicle only the return of the MacMillan expedition, with the definite statement that Peary's "Crocker Land" is only a mirage; and as we go to press Stefansson is reported safe at Fort Yukon, Alaska.

Astronomy

While the whole world has been torn by one of the greatest conflicts of history, the celestial spheres have been majestically pursuing their orbits quite unperturbed by the stirring events on one of the tiniest of their number. In one respect, at least, 1917 has been a noteworthy astronomical year. Were this the Fifteenth Century, we might find some sinister portent in the fact that there were seven eclipses in the year of our entry into the war. The last time there were seven eclipses in one year was in 1805, and there will be only two more years with as many eclipses in a century-and-a-half. Those who are superstitiously inclined may discover some special significance in the fact that the first lunar eclipse, that of January 8th, was a remarkably dark one—the moon instead of appearing as a dull red disk was almost entirely obliterated from view. The scientific explanation of this was that the sun's rays, refracted through the earth's atmosphere were cut off by a belt of clouds, so that the moon did not receive its usual ruddy illumination. The annular eclipse of the sun on December 13th was interesting because the central line of the eclipse passed squarely over the South Pole. Of the seven eclipses of the year, three were lunar and four solar.

Nineteen-seventeen has not been a remarkable comet year, nevertheless, we have had three new celestial visitors. The first comet was discovered by Mellish and also independently discovered in the Southern Hemisphere. It arrived at perihelion on April 12th. Comet *b* was discovered by Schaumasse, at Nice, on April 25th. Wolf's comet which was discovered in 1916 arrived at perihelion on June 16th, and its nearest approach to the earth took place on August 1st, when it was 95,000,000 miles away from us. It failed to develop into a conspicuous object as had been predicted the year before. On September 14th, Wolf discovered the third comet of the year, which was at first thought to be a reappearance of Encke's comet.

One of the most notable events of the year has been the installation of the great telescope at Mt. Wilson. This is a 100-inch reflector—by far the largest in the world. The mounting of the telescope has been under construction for several years, and was much delayed by the war. The parts were so large that they required the machinery of a shipyard for their construction. The telescope is mounted in a dome 100 feet in diameter and 100 feet high. The hauling of the huge glass mirror and of the heavy sections of the telescope mounting up the steep mountain road to the summit of Mr. Wilson, 6,000 feet high, and the erection of the mammoth but highly sensitive instrument without mishap, was an engineering accomplishment of no small importance. With the 60-inch reflector at Mt. Wilson Observatory, 219,000,000 stars may be detected. It is estimated that, with the great 100-inch reflector, 300,000,000 stars will be brought under observation.

Standard Steel Cargo Ships for the War Zone

A Yard for Building 150 Steel Ships by Quantity-Production Methods

One of the new yards for building our merchant fleet. This yard with 28 slips is building 150 ships

ACTING as Agent for the United States Shipping Board Emergency Fleet Corporation, The Submarine Boat Corporation is now completing at Newark, N. J. a shipyard for the building of 5,500-ton, standardized, steel cargo ships. The yard is located at Port Newark Terminal, 15 minutes distant from the heart of the city of Newark, on Newark Bay and comprises 125 acres of land which is ideally situated for a shipyard. The land has a frontage of one-half mile on Newark Bay, where the shipyard is built. Twenty-eight shipways are now under construction. A number are already completed. On the south end of the property a dock, one mile in length has been built, where the ships, when launched, will be moored while they are being fitted out with the propelling apparatus, including turbines, boilers, deck machinery, etc.

On Thursday morning, December 20th, John Hunter, inspector for the Shipping Board Emergency Fleet Corporation drove the first rivet in the keel of the first of the 150 ships to be built at this yard. This marks the beginning of a tremendous drive for the production of tonnage, which everyone knows is of such vital importance to win the war.

It is characteristic of American energy and ingenuity that this enormous yard was over 90 per cent completed in 76 days. The yard is, in reality, an assembly point which will be fed by over 46 steel-fabricating shops accustomed to manufacturing steel material for skyscrapers, bridges, gas plants, etc. The number of workmen required on the hull construction alone, when the plant is going at full speed, will be over 15,000 while the number of workmen employed in different locations, from the Atlantic Coast to as far west as Milwaukee, in fabrication of the raw material will represent over 30,000. The Newark Bay Shipyard will be the main assembly point for hull material as well as the turbines, deck machinery, etc., that go to complete the entire ship. Over 15 miles of industrial standard-gage railroad tracks will be laid on the property, and over 30,000 piles have been driven for the shipways. The main buildings are of steel, two of them 700 feet long. The Administration building of 40,000 square feet already is occupied by over 400 employees. The other steel buildings, comprising machine shops, storage warehouses, equipment shops, etc., are rapidly nearing completion.

The workmen for erecting the ships will come from all parts of the country and they will represent trades which heretofore have been utilized in office building and bridge construction. Schools will be established at the plant for training these men in ship work, and it is expected that men accustomed to structural steel erection can very soon become, under this instruction, competent for steel ship building.

The housing conditions at Newark have been a problem that the shipyard has had to contend with; but through the Board of Trade of the City of Newark, and the Emergency Fleet Corporation, Washington, additional housing facilities will be afforded in the near future to take care of the great number of new men who will be called upon to work at this plant. While the demand for new houses is of the greatest importance in connection with the Newark Bay Shipyard, temporarily the city of Newark, Jersey City and New York can take care of the large number of men who will be employed; for within a circle of ten miles of the plant over 7,000,000 people reside, making this location one of the most ideal for this enterprise.

The 5,500-ton ship which the Submarine Boat Corporation will build at this yard has been designed and worked out so that structural steel can be utilized in its construction; but it will equal in every way the highest standard of shipbuilding, *and the ships when completed, will carry the highest classification from both English Lloyd's and the American Bureau of Shipping.*

The program is for this yard to complete 150 of these ships in the shortest possible time, and the laying of the first keel on Thursday, with two other keels to be laid this month, crystallizes the effort of the past three months to complete the yard for this important work.

The building program calls for three keels to be laid in December, which will be fulfilled; additional ones in January and each month thereafter, it being possible to lay 28 keels and have 28 ships under construction at one time in this yard. With these unparalleled building

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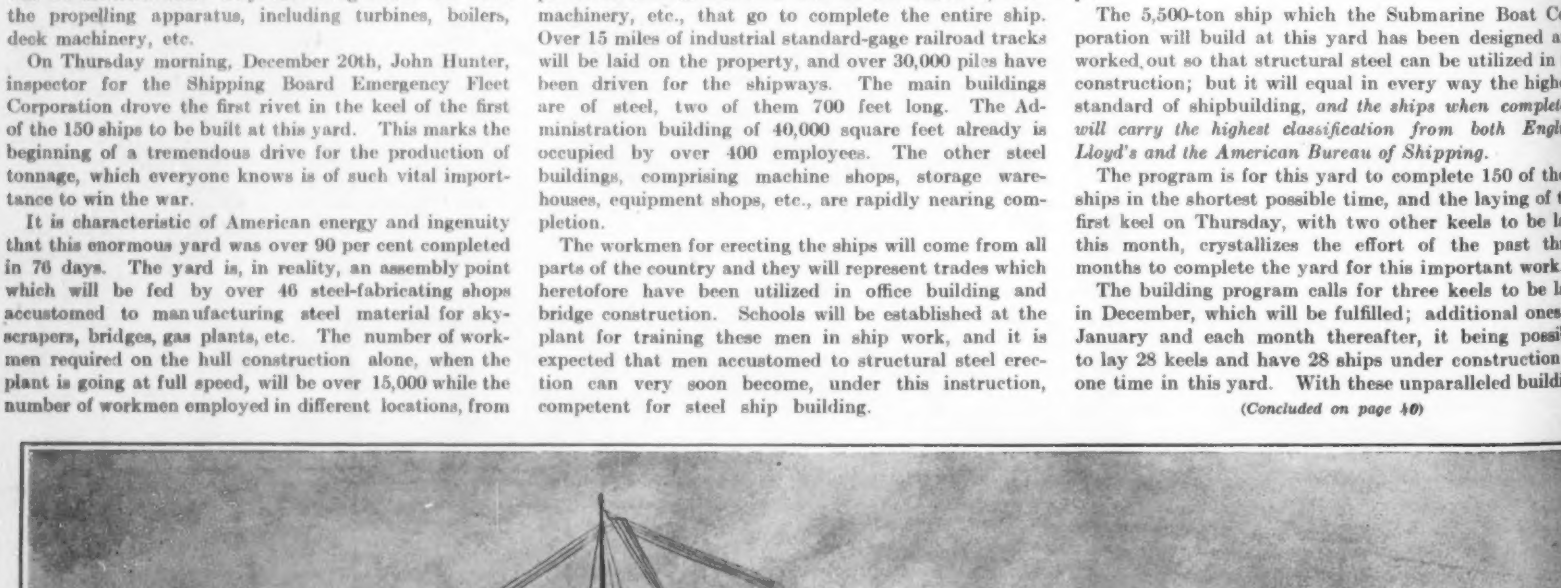


Standard, steel, 5,500-ton 11-knot, steel ships, now being built at the Newark Bay plant shown above

This is a "fabricated ship," which means that eighty per cent. of the steel will be machined, punched and drilled at bridge and steel-building shops in the interior, and will reach the shipyard ready to be built into the ship.

Scientific Accident Prevention in the Large City

Some of the Means of Attaining This End Developed in St. Louis

By C. L. Edholm

THERE may be a time when we will look back to the period of avoidable street accidents with feelings of wonder that they were tolerated so long. The list of deaths and accidents causing serious injury grows longer day by day, but as it is difficult to place the responsibility in most cases, very little is done to remedy matters. Perhaps the best showing in accident elimination has been made in St. Louis, under the direction of Charles M. Talbert of the Board of Public Service. Mr. Talbert has attacked the problem by charting the points of greatest danger in the network of streets, just as hidden rocks and shoals are charted for the benefit of seamen. After finding out where the most accidents occurred, it was possible to discover the reason for them, and in many cases to eliminate the cause, or at least to warn the public of its presence.

The testing cabinet which determines whether a headlight is too bright or too dim

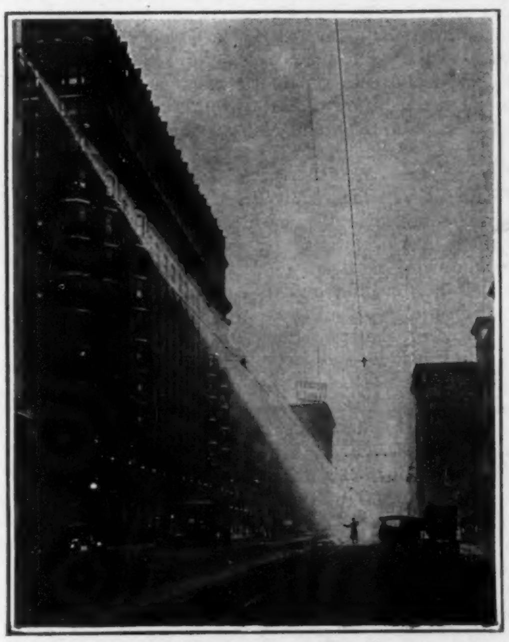
On a large map of St. Louis the places where street accidents occurred are indicated by spots; large spots show where many mishaps occur and small ones show where they happen less frequently. The records of the Police Department and the Street Railway Company supply the figures. The spotted map surprised the police and some others who thought they were supplying the best possible protection, for many corners that were thought to be fairly safe showed a casualty list as great as that on the dangerous crossings that were guarded by traffic police. Investigation revealed causes that were not suspected. In several cases it was found that the car sheds of the railway company were responsible; cars backing in and out resulted in collisions or other trouble. In other danger spots it was found that the conditions of the street were at fault; so here an awkward jog was straightened, and there a high crowned roadway with asphalt surface was reduced to prevent skidding. Where conditions could not be remedied so simply, it was at least possible to warn the police and the public that certain corners were dangerous. It is being considered, and the proposal may be carried out, to place traffic signs at the approach to such points, in some such form as this; "Eighty accidents here last year! Be careful."

An unusual chart of traffic conditions was prepared that shows the volume of traffic on each block of the down town section. A comparison with an ordinary map drawn to scale makes it clear that there are certain points and even certain streets of undue congestion; and measures will be taken to guard these.

Two mechanical devices for the prevention of street accidents were developed and found to be practical. The first was the result of traffic policemen being struck by the automobiles they were supposed to regulate. The imperfect lighting of the streets, with many conflicting rays coming from various directions, made it difficult for the motorist to see the traffic policeman's signal or even to observe him at all, and consequently several officers were injured while on duty.

The solution of this problem was correct lighting of the street intersection, so that the signals might be seen clearly; and as a light from the side would cause a glare, it was decided to direct it from above. Accordingly a powerful searchlight was placed in an upper story of a nearby building, where it would project its rays down upon the officer. As an additional safeguard, the use of a white waterproof coat and white gloves with large gauntlets has been adopted for rainy or foggy weather. Half a dozen searchlights of this description are now in use at the dangerous corners, and this type of accident is greatly reduced.

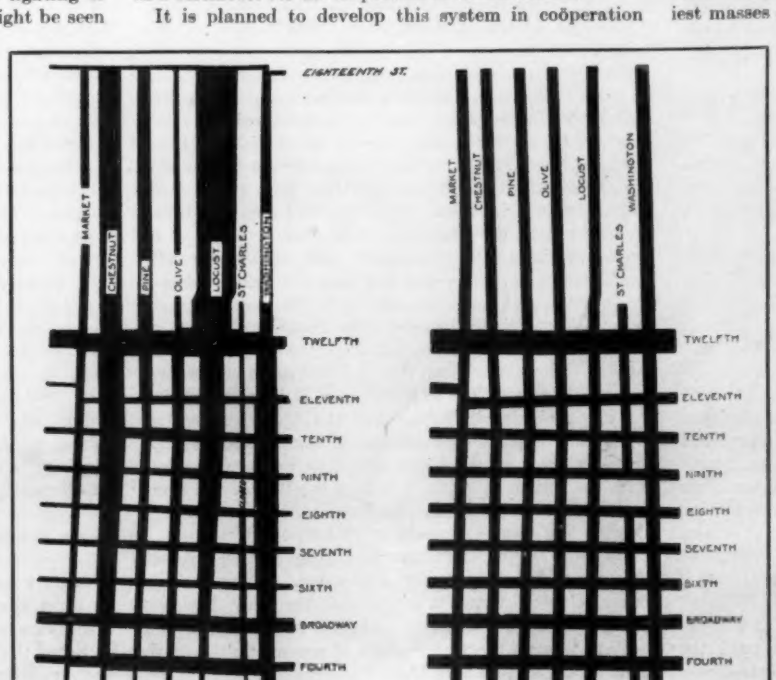
In order to standardize the headlights of automobiles and eliminate glare, a cabinet was devised for testing the lamps. The box is five feet high, three feet wide and two and a half feet deep. A slot in the front admits light from the headlights, which falls upon a "test curtain" within the cabinet, and this can be observed through a peep hole at the side. After selecting a car on which the lights were just right, the machine was placed at a measured distance from the cabinet and its lamps were directed upon the slot. Back of the test curtain was an electric lamp, and by means of a rheostat this was regulated so that its light balanced exactly with that of the automobile lamps selected as standard. In testing the headlights of cars, the rays upon the test curtain are observed through the peep hole, and if they show brighter than the light within, at the point where the two lights meet, then the headlight is considered glaring and must be reduced. If the auto light shows dim beside the standard light, it must be increased.



Throwing the spotlight on the traffic officer to protect him from the traffic

When the two lights balance, the car owner receives a card stating that his lamps have been passed upon, and this may be pasted on the lens of the headlight, serving as a certificate for the inspection of traffic officers.

It is planned to develop this system in coöperation with other large cities and decide upon a standard that will be accepted by all. Bulletins will be issued by the National Committee from time to time, bearing on the problems of safety in the streets, and suggestions will be welcomed for plans to reduce the number of accidents. Not only by city ordinances and mechanical devices, but also by a campaign of education, it is hoped that the public will be induced to use greater care; the pedestrian as well as the driver of motor vehicles and street cars.



St. Louis traffic map. At the left the streets are shown according to the traffic carried; at the right according to width. The comparison is of great value

Building an Ice Proof Bridge

IN the spring of the year practically every railroad company and every county board is confronted with the problem of protecting bridges from ice jams. In this regard the Platte River of Nebraska is one of the most perplexing of all streams. The Platte does not follow a very definite channel, but spreads itself over the surrounding country for a half mile or so. It is usually a very shallow stream, but in the spring, when its tons of ice are loosed, the river becomes formidable indeed and only the use of dynamite can prevent ice jams from tearing out many of the bridges. Because the stream is usually shallow and has no definite channel the ice situation is much more serious than in the case of an ordinary river.

So when it came time to erect a bridge across the Platte near Yutan, about forty miles west of Omaha, the Burlington railroad decided to utilize all its past experience in dealing with this river and build what would be an ice proof bridge at moderate cost. Needless to say, the bridge is somewhat unusual. The average onlooker would be puzzled at first, seeing a huge length of trestle work in the middle and steel girders at each end. "What!" he would probably exclaim. "I thought they always put the steel work near the middle and the trestles at each end."

The first problem was to make the river adopt some sort of a definite course. Instead of resorting to dredging, the river was made to cut out two very decided channels of its own. The Platte River is remarkable in that there is a tendency for two currents to exist, one at each side, instead of one in the middle. At this point the river is about 2,000 feet wide. The proposition was simple and economical enough. Each side of the stream was filled in with a solid embankment or approach until the width was 1,383 feet. This deflected the water into two channels, one under each end of the bridge. The extra water is sufficient to deepen these places, furnish a swift current and so prevent ice jams. With two channels definitely established the center of the river is calm enough and for that reason a 700-foot trestle was used there, a very economical feature. At each end of the bridge four 75-foot girder spans were placed over the deep places. The selection of these long girders was another step in eradicating the ice trouble, since ample room was provided between the piers for the very bulkiest masses of ice to pass through.

The piers supporting the girders are of concrete, extending 40 to 60 feet below water, the last point in getting rid of the ice difficulty. In constructing the piers open caissons were used at first, but hard sandstone was encountered and the work could proceed no farther that way. With no material change in plans, pneumatic caissons were adopted and men, working on the river-bed with compressed air to keep out water, excavated sand and rock.

The girder spans were placed from temporary supports erected on one side. This temporary bridge made it a comparatively easy task to handle the concrete for the piers and here an interesting method was used. A concrete mixer together with material was placed on a flat car. The car could be moved along the temporary bridge to any point where it was desired to work. All that was necessary was to connect the mixer with the pier by a spout and pour the concrete directly down into the form. Much of the work was done in cold weather and in such cases the freshly laid concrete had to be kept warm with a steam hose. In order to make the bridge as fireproof as possible galvanized iron was laid on the floor of the trestle to prevent live coals falling from engines kindling a fire, while other portions were coated with fireproof paint. The structure cost but $125,000.

Development of the Pneumatic Tire

How It Has Been Affected in Turn by Horse-Drawn Vehicle, Bicycle, Passenger Car and Now the Motor Truck

ALTHOUGH a proved success the first time it was tried out under actual conditions, the pneumatic tire was laid aside and forgotten for a great number of years. Then it was again reintroduced for use on bicycles. When the automobile first appeared, the pneumatic tire was altered to meet the requirements of the power-driven vehicle. Patents and infringements seem to have figured in no small way in the development of the pneumatic tire, and much of its history if told in detail would take the form of legal records. At any rate, from its earliest application on the horse-drawn vehicle to its latest application on motor trucks, the pneumatic tire has had a most remarkable history.

Londoners sitting and promenading in one of the parks of the British metropolis one day in 1846, were treated to a genuine surprise when along came a brougham equipped with the most extraordinary wheels. For one thing the tires of these wheels were remarkably large and certainly did not add to the appearance of the vehicle. But the real feature of interest was the ease with which the vehicle rolled along the road; indeed, it seemed to float along without jar or noise. Only the beating of the horses' hoofs on the hard road could be heard.

As for the construction of these first tires, it ran about as follows: A thin flat iron tire, ½-inch thick and four inches wide, was first placed over the felloe to bind the wheel together and afford a foundation for the pneumatic arrangement. A strip of leather about a foot wide was placed round this, and upon that another metallic tire somewhat thinner and narrower than the first. These three tires were then secured by large headed screws or bolts passing through the felloe, and secured on the inside of the latter, so that they could not draw out. Next, an india-rubber tube was placed in position, and over that another strip of leather, riveted one side to the overlap of the first leather belt, and laced to it on the other.

Means were provided for inflation in the form of a nipple on the tube, which was projected about half way through the felloe. To this nipple was attached a small tube that passed completely through the felloe and projected sufficiently to admit of a brass cap being screwed on the end upon a leather washer, in order to make an airtight joint. A metal collar sunk into the felloe served to keep the pipe in its place.

For inflating the leather-encased tire a "condenser" or handpump was used, and it appears that this instrument was not unlike those employed at the present time.

The brougham equipped with the first pneumatic tires covered the first 100 miles without trouble, convincing all who saw it that the idea was entirely practical. Much of the road traversed was not of the best; in those days the smooth, hard road surfaces of today were few and far between. And the brougham went on piling up mileage until at the end of six months over one thousand miles had been covered with the tires still in excellent order.

Tests were conducted by interested parties with a view to determining the efficiency of the pneumatic tires. With two carriages weighing 10½ cwt. each, one fitted with the pneumatic tires and the other with ordinary tires, the results were as follows: On a comparatively hard and smooth road the actual draught of the rubber tires was 28 pounds, while that for the iron tires was 45 pounds, showing a saving in power of 60 per cent. Over newly broken flints these figures became 38½ and 120 pounds, respectively, or a saving of 310 per cent. Right here it is important to direct attention to the fact that the pneumatic tire, then as now, made the best showing over rough roads.

These pioneer pneumatic tires were known as "patent aerial wheels," and were the invention of Robert William Thomson who patented the idea in 1846. Thomson, a civil engineer by profession and a resident of London, took out a French patent in 1846 and an American patent the following year.

Thomson was undoubtedly the father of the present-day pneumatic tire; he not only suggested and worked out a tire design, but actually put his ideas to a practical test. In 1847 a horse-drawn vehicle equipped with pneumatic tires appeared in the streets of New York city, and mention of it is to be found in the SCIENTIFIC AMERICAN of that time. Whether or not the tires were designed after the ideas of Thomson which were made known in his American patent, is not disclosed; nor is the name of the inventor given.

For some reason or other the pneumatic tire was entirely forgotten after 1847, and it was not until the introduction of velocipedes that the idea was reintroduced In the absence of a reason for this gap in the history of the pneumatic tire, perhaps the reader will pardon the writer for suggesting one that is obvious and logical.

Appearance was a paramount consideration during the middle part of the last century; in dress, in the ornate carriages of the period, in the home—indeed, in everything the question of attractiveness figured before anything else. One has but to recall the locomotives of that time, with their bright paint and gilt trimmings and ornamental fittings, to find proof of the esthetic tendencies of the people. Now consider for a moment the graceful horse-drawn coach or brougham with its sweeping lines and slender wheels; and then, without changing the rest of the picture, place a pneumatic tire encased in a four-inch or five-inch leather jacket on each wheel! Therein you probably have the answer to the lack of interest in the pneumatic tire with its many proved advantages, during the next three or four decades.

The introduction of velocipedes and bicycles created new interest in the tire question. Soon the leading rubber manufacturers of England were at work on the rubber tire problem and filed applications for patents on the solid type. Some of these patents dated back to 1871, but most of them began in the early '80s. In substance the patents varied as to the means of attachment, the compounds used, and the general design. One patent, for instance, called for the employment of emery in the tire compound in order to give it more lasting qualities. Another was made up of sectional blocks "to avoid vibration." But only in the case of the McIntosh interests did any one think of any but a solid tire. In this particular case a patent was applied for in 1884, calling for a hollow-center tire, or porous or spongy center, in order to obtain greater resiliency.

The real beginning of the present-day pneumatic tire, however, starts from the year of 1888, when John Boyd Dunlop, a veterinary surgeon of Belfast, Ireland, secured his first patent on such a device. This tire consisted of a rubber tube with means for inflation, bent round each of the wheels of a tricycle owned by a young son of the inventor, and held in place on the rim by wrappings of tape. A year later Dunlop took out another patent, the two patents laying the foundation for the tremendous tire manufacturing business which followed.

The work of A. J. Thomas, an American, must not be forgotten. In 1889 he secured three patents on a tire of practical design, but it appears that he never commercialized his idea. However that may be, his patents were often quoted in litigation suits which followed.

Things progressed rapidly and in 1895 the Dunlop interests took the form of a $25,000,000 corporation, which for a while enjoyed a practical monopoly in the pneumatic tire field in Great Britain, and made extensive sales elsewhere. It is of interest here to note that Dunlop's patents figured but little in the success of the great tire-manufacturing business; for it was soon realized that his inventions covered nothing that was not anticipated in the Thomson patent of 1845. With full appreciation of this fact the Dunlop interests soon set to work acquiring other patents. Meanwhile on the Continent the Thomson patent was held to have anticipated many later inventions, so that outside Great Britain the Dunlop products never had patent protection.

Fastening a pneumatic tire to the rim by wrapping tape about it was too crude a method compared to the neat methods previously used with solid rubber tires. Casting about for better means of attaching their products, the Dunlop interests came across the patent of Charles Kingston Welsh, who had been granted an English patent in 1890. In addition to an air tube, Welsh's patent provided a cover of rubber and canvas having thickened edges through each of which ran a reinforcing wire. The last-mentioned member formed a complete circle and when applied to the rim it engaged in grooves especially shaped for the purpose.

Welsh was not alone in his tire cover or "shoe" and method of holding, for an American patent was granted to A. T. Brown and G. F. Stillman of Buffalo, N. Y., for the identical idea in 1892. And the Dunlop interests, admitting the fact of independent conception and appreciating the value of this American patent, acquired it for the sum of $100,000. In fact, the Brown and Stillman patent served as the foundation for the extensive Dunlop business in America at a later period.

By now the pneumatic tire was firmly established and the demand was steadily increasing. Many rubber manufacturers were attracted to the tire business because of the gigantic proportions it had attained, and not a few began the manufacture of pneumatic tires with little regard for patent rights. The Dunlop interests soon found themselves deep in litigation in an attempt to defend their monopoly. Every feature of construction of the tires was the subject of actions at law in the various courts, according to Henry C. Pearson in his work entitled *Rubber Tires*, leading finally to a decision in favor of the Dunlop organization rendered in the House of Lords, the highest English court of appeal. But the infringements kept on and litigation continued, the Dunlop company in one year being a party to 162 pending suits. In some cases the company was unsuccessful, with the result that its monopoly was gradually narrowed. On the evening of September 16th, 1904, the date of the expiration in England of the Dunlop-Welsh patent, at a dinner given by the organization a copy of the patent was consigned to the flames, and the chairman remarked that the expiration could not be viewed with feelings other than those of relief and equanimity. The Stillman and Brown patents expired in 1909.

In 1890 the Dunlop interests acquired the patent rights to the invention of William Erskine Bartlett, covering the clincher principle of tire attachment. Instead of wires for holding the tire in place, the cover was made with beaded edges which engaged the incurving flange of the rim. The tire was first inserted in the rim and then inflated so that the beaded edges became tightly wedged in place. It is said that $100,000,000 was paid for the patent rights; besides, the vendors retained certain "shop rights" under which they continued to make and sell tires on their own account, as well as making tires for the Dunlop company. The Bartlett patent was certainly iron-clad, for in England it was never successfully attacked. Its inventor, although living in England and managing the concern which sold the patent rights to the Dunlop interests, remained an American citizen until his death.

On October 21st, 1904, the Bartlett patent expired. This resulted in throwing open the British market to the Michelin and Continental tires manufactured in France and Germany, respectively, which, previously to this time, could only be sold in Great Britain under royalty arrangements.

Coming to our own country, we find that a clincher tire was developed and patented by Thomas B. Jeffery in 1891 and 1892, and made its initial commercial appearance on the famous Rambler bicycles in the days when each bicycle maker equipped his product with his own type of tires. But so satisfactory did the Jeffrey tire prove in service that it was soon placed on the general market under the name of the G. & J. tire.

For bicycle use the single tube tire became the most popular. However, with the advent of the automobile the clincher tire took first place in practically every country where motor vehicles appeared. The G. & J. patents were acquired by a subsidiary company of a large American rubber corporation, and until their expiration in 1909 they were the basis of a monopoly which exacted due royalties from manufacturers operating under them.

No one will gainsay that there has been ample variety shown in automobile tires; each type, with few exceptions has had just claim to novel and distinct features. Yet in the main all automobile tires have been based on the clincher principle. In France this principle was adopted by the Michelin interests, and in Germany by the Continental and other interests. Among the many improvements may be mentioned that of the early Fisk tire, in which each edge of the shoe or cover was held in place on the rim by being clamped between a continuous metal plate and the edge of the wheel rim.

Turning once more to bicycle tires, we find the single tube tire patented by Pardon W. Tillinghast in 1893 and first introduced by Col. Albert A. Pope on his Columbia bicycles. This tire was very popular in its day and became a sort of standard type in the United States. Again we find a case of similar ideas being worked out independently and contemporarily in our country and in England. This time it was A. Boothroyd, who in England worked up a design similar to that of Tillinghast's. He never patented his idea, however, so that it became public property. Tillinghast's patent expired in 1910.

In 1893, special tire fabrics were patented in Great Britain and in the United States by John Fullerton Palmer, an American. The fabric was what is called in weaving "all warp," having no weft threads crossing the warp. These warp threads, according to Mr. Pearson in *Rubber Tires*, were laid on to sheet rubber, and for use as a tire were cut into strips of the desired width, the ends of which were cut on the bias. A strip was helically wound on a mandrel, and the opposite edges of the strip were brought into contact in the winding. In this manner a tube was formed. Another strip of the fabric of the same width was superimposed on the first and helically wound in the same manner but in the opposite direction. The four ends of the two strips were manipulated in such a manner as to form this tube into

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Keeping the Cooling System Hot

Regulating the Temperature of Automobile Radiators in Winter Weather

By John S. Harwhite

THE average cooling system does its work *too* well. This statement may be received with surprise by many of those motorists familiar only with the older types of cars which were wont to boil on the slightest hill and under almost every condition requiring the use of low or second speed. Conditions have changed, however, in a manner that works somewhat against the efficiency of the modern car, for as radiator capacities and cooling efficiencies have been increased, fuel quality has been decreased to the point where it becomes necessary to supply it with more heat than ever in order to obtain satisfactory vaporization. But engine and carburetor engineers have helped to solve the problem, to the seriousness of which the efficiency of the radiator manufacturers contributed, by supplying exhaust stoves and hot water pipes to the intake manifold and carburetor bowls.

With the present-day grade of fuel the most effective results are obtained when the engine is kept at a temperature only fifteen or twenty degrees under the boiling point. In fact, if we could find some liquid which would materially raise the boiling point of water, we would obtain a greater efficiency from our engines by operating them at cooling-water temperatures of, say, 225 or 230 degrees. At about this point, however, the average type of cylinder oil will not give the same degree of lubricating efficiency as when the metal parts over which it is spread are kept at a lower temperature by cooler water.

It is in winter, especially, that the average cooling system does its work too well. It is hardly to be expected, however, that pump, water jackets, radiator area, and general cooling capacity could be designed to maintain the engine at the same operating temperature at all times under conditions which often give as much as a 90-degree variation in atmospheric temperature.

By covering the radiator with a robe or fitted cover, the amount of surface exposed to the air may be reduced to the point where the temperature of the water will be retained for a long period. By keeping the radiator thus covered when the engine is first started, the water can be brought to its normal temperature much more quickly than would be the case were the entire surface of the radiator exposed to the cooling blasts of the air sucked through by the rapidly-revolving fan. Whenever the amateur driver thus takes liberties with the efficiency of the cooling system, however, he should protect his engine from overheating by the installation and careful observation of a radiator thermometer which records the temperature of the cooling water.

The use of robes and covers which must be operated or adjusted from the ground, however, is not in keeping with the demands of the modern motorist who feels that all parts of car operation should be made as automatic and labor-saving as possible. Inasmuch as it is the temperature of the portion of the engine with which the raw fuel and mixture come in contact which most directly affects the efficiency of operation, the temperature of the water in the radiator is of no concern, except as it represents engine temperatures. It is only because the average car is designed with a water circulating system which forces the cooling medium directly from the bottom of the radiator, through the jackets, and up into the top of the radiator, that radiator temperature is taken as a criterion of engine temperature. Probably the most popular system of engine temperature control is that employing a thermal coil, or a thermostat, to actuate a by-pass controlling the flow of the water through the radiator. When the water is cold the passage leading to the radiator is closed and the pump forces the water only through the engine jackets. This condition continues until the engine has brought the water to a temperature of about 180 or 190 degrees F., at which the thermostat automatically opens and allows the cold water from the radiator to flow in, the radiator thus becoming a part of the circulating system. By this means the amount of water which must be brought to the desired temperature is only a small portion of that used in the entire system, and consequently the engine attains its normal efficiency after but a few moments of operation. The user of such a system, however, must remember that during the first few moments of operation the radiator is exerting its full cooling efficiency, aided by the suction of the fan, upon the water which is not receiving heat from the engine. This means that the water in the radiator of a car employing this system can actually become frozen when the engine is started, unless the radiator is covered or some form of anti-freeze solution is employed. Alcohol is the most popular freeze preventive, but it has not always been suitable for use in cars having this thermostatic control of water circulation, for the reason that its boiling point is below the temperature reached by the water before the passageway leading to the radiator is open. It is evident, therefore, that under this condition, the alcohol would soon boil out of the cooling system, for the thermostat continues to operate until eventually the water in the entire cooling system is maintained at a temperature in the neighborhood of 180 degrees. The above-mentioned difficulty, however, has been overcome during the last year or two by the installation of a condenser on certain cars which serves to collect the evaporated alcohol, restore it to its liquid state, and return it to the cooling system.

Another system of engine temperature control does not depend upon the restriction of the circulation of the water, but on the amount of air admitted to the radiator instead. The forward portion of the radiator cells is provided with a series of horizontal shutters, similar to the Venetian blinds found on many old-fashioned houses. When these shutters are moved, so that their flat surface lies horizontal, the maximum cooling effect of the radiator is obtained, for the air passing through is obstructed as little as possible. By tilting these shutters, however, so that their flat surface lies in a vertical plane with the edges slightly overlapping, the entire front of the radiator will be completely covered and no cooling air can find its way through the cells of the radiator. A radiator thermometer is used in connection with this system and even in warm weather, the car should always be started with the shutters closed. The entire mass of the cooling water will soon be brought to the most efficient temperature and the shutters may then be opened from the driver's seat in accordance with the demands of the outside air. When coasting down a hill on a cold day, the shutters may be closed entirely in order to conserve the heat in the radiator and jackets and make the engine more efficient when it is next called upon to work on

(Continued on page 40)

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Partly Inflated Tires

To the Editor of the SCIENTIFIC AMERICAN:

In the November 3d issue of your magazine there was an article entitled "Partly Inflated Pneumatic Tires," which had been called to my attention from several sources.

Theories similar to that advanced by this article have been put out frequently in the past by individual owners of cars, and in almost every instance the fallacy of their reasoning has been so obvious that comment did not seem necessary.

But the article in question appearing in a paper with the reputation of the SCIENTIFIC AMERICAN for accuracy, might very possibly lead to considerable harm if it were successful in inducing trusting motorists to follow its precepts.

In one thing the writer of the article is correct, and that is, that there will be fewer broken springs and less jolting of the car if the tires are under-inflated.

Obviously this is true, but the pneumatic tire was not designed for this purpose. It is expected to serve as a resilient cushion for the car that will absorb little shocks and bound away from heavier ones, in the latter case transferring the burden of cushioning largely to the springs.

The real difficulty with the reasoning in the article mentioned was that the writer was treating of an automobile tire as though it were essentially constructed of rubber. As a matter of fact the automobile casing is composed very largely of layers of tightly woven fabric.

Realizing this you will understand where the writer's analogy to the child's rubber balloon falls down. If the casing were really of rubber and were not distended too tightly by the air pressure, probably it would yield considerably before being broken or punctured by sharp objects. But being largely fabric, before it has yielded very far the unstretchable layers of fabric are going to break or be cut through just the same way that a fabric balloon would be unless sufficiently supported by the pressure of the air from within.

In other words, the resiliency of a pneumatic tire, is as its names implies, due not to the rubber used in its construction, but to the cushioning effect of the air. And if there is not sufficient air to provide an adequate cushion, the casing suffers accordingly.

Tires are designed to bend about one-twelfth of their cross-sectional diameter. In flattening out this much considerable heat is generated between the various plies of fabric, but tires are so designed that they can stand this destructive internal heat for a good long time provided the flexing does not become more exaggerated.

The balance of a properly constructed tire is such that the tread will be worn through about the time the carcass is ready to give out from the constant flexing.

But if the tire is run with considerably less air pressure than it was designed to carry, the flexing is going to be very much increased, the strain on the plies of fabric will be greater, and the carcass will break down long before the rest of the tire is worn out.

This of course, means a considerable economic loss, which is undesirable at any time, but which is particularly undersirable at present.

So I should like to emphasize that the only real way to determine tire pressure is by use of an accurate gage. The proper pressure, of course, varies with the weight of the car and load carried, and can be determined in any given case from a carefully worked out scale published by leading tire companies.

This pressure should be maintained within a ten-pound limit at all times and the tires tested and reinflated at least once a week. By being careful on this one point alone it is possible to increase the tire mileage from ten to fifty per cent.

P. D. COLLINS.

Akron, Ohio.

The Shortage of Draftsmen

To the Editor of the SCIENTIFIC AMERICAN:

I read with interest in a recent issue your article entitled: Wanted: Men for the Army Behind the Army. The part that I wish to lay emphasis on is this: The needs of the army are large especially in the Ordnance Department. Of the first importance is the securing of mechanical draftsmen.

I would suggest that if the Government wishes to secure experienced mechanical draftsmen it should abolish the requirement of a college education. Draftsmen are not made in colleges, but as a rule derive their education from practical experience, and I know of no better source.

Having spent several years in this particular field, I can say that some of the best draftsmen that I have come in contact with were minus the college education.

GEO. T. CHAPMAN.

Hartford, Conn.

Saving Tin Plate

To the Editor of the SCIENTIFIC AMERICAN:

Inasmuch as there is a shortage of tin metal (block tin) and consequently of tin plate, I write to suggest that possibly the problem could be solved by coating the sheet iron or sheet steel on only one side with the tin, this side being turned inward in making tin cans, as there is ordinarily little danger of the outside of the cans getting wet and rusting, the average time required for the tin can to get from the factory to the consumer of the canned goods being probably but a few months. And surely inventors can arrange some practical way of making charcoal plate, coke plate or crystallized tin-plate so that only one side will be coated. Perhaps the process would be cheaper than coating both sides, aside from only half as much tin being necessary. According to a statement which I saw recently, the amount of tin now used on tin-plate is two per cent of the total weight.

ELMER G. STILL.

Livermore, Cal.

Roads—Good and Bad

How They Came To Be and What They Mean to the User

ONLY within very recent years has the paramount influence of roads upon the nation's life been adequately realized. Only since such realization became a fact has proper attention been given the various aspects of the road problem. We have always before located our roads according to the considerations of the moment; we have given the forces of nature free rein to determine their character; we have used them when we would and when we could for such traffic as we have had to send over them, with never a thought that there were ways of fitting the road for better use and of fitting the use to the road, or that there was any particular profit in thinking about our roads at all. With the automobile replacing the horse as fast as it can, however, we have been driven to think about them. The cost of poor roads has been brought home with staggering force, and over an ever-increasing proportion of the country we have set to work to eliminate that cost. But in doing this, we are too apt to overlook the fundamental fact that a road located in the first place with poor judgment can never be made to give complete satisfaction.

Unfortunately in many instances the course of settlement has so followed the roads that it is not now practicable to change an originally bad location. This is not invariably the case, however; it is not even clear that it is usually the case. In any event we are continually laying down new roads, and there is surely no valid reason for refusing to learn from the mistakes foisted off on us by our ancestors. These early road-builders meant well; but they had small knowledge and smaller facilities. Their conception of a road was usually that of a trail for horseback riding and the driving of two or three people or a light load, rather than that of a thoroughfare for heavy trucking, the transport of goods to markert, etc. For these early settlers, in almost every section of the country, used their crops instead of shipping them, so that in large districts the only use of the roads was for the interchange of social and business calls.

Under these circumstances the road was not really a road at all, but just a track or trail. Accordingly it was not something to be built, but merely something to be laid out; and very naturally it was laid out by rule of thumb. If there was a river, the early roadbuilders followed that river. In doing this, it is an actual fact that they frequently minimized the amount of clearing that had to be done by building the road on the very ragged edge of the stream. Such a highway, of course, is a mere quagmire during half the year, wholly unsuited to anything except the very light traffic for which it was primarily intended.

If there was no watercourse where they wanted to go, if the route lay across rather than along the valleys, our first road-makers looked upon the straight line, the shortest distance between two points, as their ideal. They approximated to this ideal by heading their road straight up the nearest hill to the top, straight across the intervening valley and up to the next summit, and so on to the destination. We once heard a humorous New England parson venture the guess that his forefathers had possessed no surveying instruments or other means of taking their bearings, and so had been compelled to run their roads out upon the top of every ridge and summit in sight, in order to see whither they were headed. A road thus constructed will remind the engineer of nothing so much as the sine curve, and to the layman it will perhaps suggest, as strongly as anything else, the teeth of a saw standing on edge. And by some strange freak of Providence it seems as though the lowest spot in the intervening valley, the one spot in which water must collect sooner and stand longer than anywhere else, was invariably right in the straight line between the summits and accordingly right in the path of the road-makers.

The conditions thus outlined are extreme, but by no means exaggerated. Where they exist, the only remedy is relocation. That this is expensive cannot be doubted; that it pays in the end is equally not open to question. A very brief glance at the graphic demonstration of the effect of steep grades and soft surfaces in increasing the tractive effort necessary to haul a given load is conclusive on this point. It will be seen from these graphics that the same load which will be hauled by a single horse over a level stretch will require two horses on a grade of two feet in 100, three horses on a four per cent incline, four on a six per cent slope, six when the roads rises one feet for every ten feet of forward progress, and no less than nine when the rise is as great as fifteen in each hundred.

A state experiment station at which road and traffic statistics are compiled

With the horse and buggy, even with the horse and farm wagon, this tremendous increase in power expenditure is not so evident. The load will usually come so far short of measuring up to the full strength of the animal that he will be able to drag it up any hill he is likely to meet, at no additional expense save in horseflesh and horse feed. The driver cannot see this cost in his bills for the week or the month, so he forgets about it. In fact, there is a certain degree of plausibility in the claim that so long as he succeeds in getting over the road without accident, he really suffers no extra cost—that his horse will eat about as much and live about as long under one set of conditions as under another. But when the horse gives way to a runabout, the whole situation is changed. The runabout cannot plant its feet squarely in the middle of the road and give a long pull and a strong pull without special expenditure of fuel. If the traction wheel cannot get a good grip on one particular spot in the road, it cannot shift to another spot and get a grip there—it has to fight it out along the original line, though it take all day. And the power for every increased effort has to be generated on the spot, by burning more gasoline at twenty-odd cents per gallon—a circumstance which possesses high visibility.

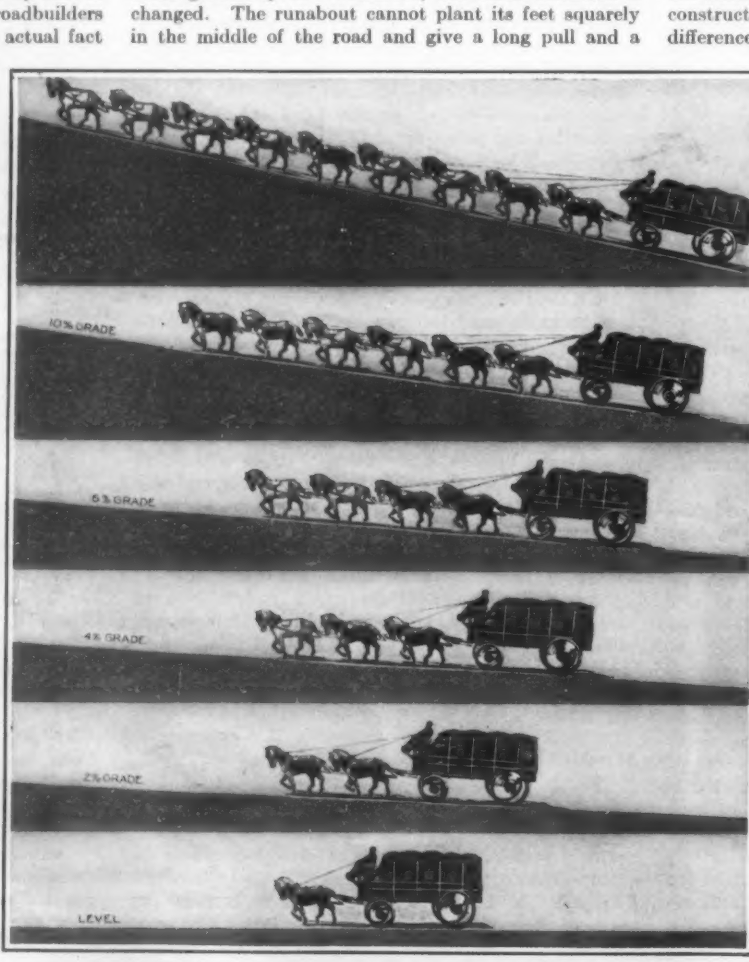
It is quite the same with soft roads. It costs little more to keep a horse when he is driven over roads inches deep in mud than when he is used on a city street—or, for that matter, than when he is hibernating in the barn. But when the day of the low-priced car dawns, the farmer who puts forth two and a half times as much power to do his hauling on a muddy road as his neighbor in the next county expends to go to market over a dry highway will find himself paying in cold hard cash for the deficiency of his roads—and that makes all the difference in the world.

The remedy is of course simple, and the cost of applying it, or the increased cost of proper new construction, is easily met out of the decreased cost of operation. The river road must be moved up the hill a few yards, even though this involve clearing and terracing on a rather extensive scale. The road through the sink-hole should be shifted, perhaps to a place where the floor of the valley is better drained, perhaps to a place where the drainage bottom is narrow enough to permit of a bridge. In default of either of these possibilities, procedure must be borrowed from the railroad builder, and the road through the damp zone put on the top of a solid and substantial embankment. Finally the saw-tooth highway must be turned over on its side so that its teeth lie flat as it curls about the bases of the hills, instead of projecting to the heavens as it climbs over. And in every case improved hauling conditions will pay for the betterment in a surprisingly short time.

When the road has finally been located in the right place, the progressive highways commissioner finds that he has fought but half his battle. His ancestors were not satisfied to bequeath to him a fine assortment of roads in impossible places; they have also made him the residuary legatee in a very ridiculous mode of road construction. It stands to reason that when the only difference between the road and the surrounding country is that the road is free of vegetation, and that when, owing to this fact and to the wear and tear of traffic, the thoroughfare gradually attains a level lower than that of its immediate environs, it is not going to be possible to keep that road dry. When the weather is damp, the road will be wet; when the weather is wet the road will be wetter; and when in the spasmodic thawing spells of the winter and through the spring the whole countryside is giving up the accumulated moisture of months, the road is bound to become a sea of mud, if not actually a temporary river-bed.

The clay road, the dirt road—any road which consists merely of two wagon ruts in the top soil—will be muddy during and after the muddy season. This has long been recognized, and there are familiar methods of giving the road a special surface of some kind calculated to make it shed water. The most primitive is that of heaping the road up into a crown in the middle, leaving a channel at each side into which and along which the water may run off. Even when such a road is packed hard it is not especially serviceable, and certainly not very durable. So we have the gravel and the trap rock roads of the north, the shell roads of the south, the sand roads and the plank roads and the corduroy roads and the brick roads of certain special localities, and finally the modern roads of asphalt and macadam and concrete and various other complexes, with foundation and intermediate layers and top surfaces worked out and constructed with as much attention to detail as is given to laying the underpinning of a bridge or a skyscraper.

The test of any road is its ability to give a dry, firm traction surface. Where the divergence is not an extraordinary one, a comparison on this ground between two roads can only be made by engineering



A graphic demonstration of the power cost of heavy grades

A load that can be hauled on a level road by a single horse will call for two horses on a two-per-cent incline, and more as steepness increases, until nine are necessary on a slope of fifteen per cent. The same proportions apply in the case of motor-driven vehicles.

methods of precision. Even between extremes, no exact statement of numerical superiority can be made without these methods. The draft required to pull a loaded wagon on different types of roads has, of course, been made the subject of repeated investigation; but no report has been extant which attempts to picture, in a form intelligible to the man in the street, the economies inherent in the high grade modern highway as opposed to streaks of dust or deep ruts in a sea of mud. Accordingly the California tests which we illustrate possess extraordinary interest.

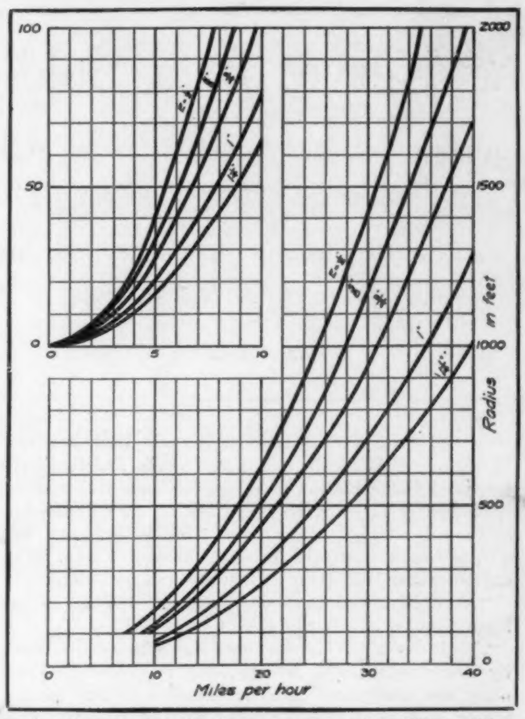
These tests were held uniformly with a load of three tons gross, consisting of a standard farm wagon loaded with sacks of rice. The motive power in the horse-drawn tests was supplied by a fine team of 1,600-pound draft horses, and in the motor tests by a two-ton truck. In each case the recording instrument was placed upon the draw bar of the wagon, so as to record simply the pull which was exerted in keeping the three tons of trailing load in motion, *after it had been started*. As far as possible all conditions were kept uniform—the same wagon, the same load, the same driver, the same horses or truck, the same speed, everything the same except the road surfaces which were the subject of the test. Even uniform weather conditions were insisted upon, each test day being warm and bright, with little wind, and with a maximum temperature of about 105 degrees. The results obtained were as follows:

Character of road	*Pull, in pounds per ton*
Loose gravel, not packed down, new road........	263
Earth road, stiff mud on top, firm beneath......	218
Eath road, fine dust	92
Gravel road in good normal condition...........	78
Concrete base, 1½-inch top.........................	69
Water-bound macadam, good condition	64
Concrete base, ⅝-inch skin top of asphaltic oil and screenings..............................	49
Unsurfaced concrete..................................	28

It is to be regretted that it was not possible to get a comprehensive series of readings over muddy roads of the first water, such as the average farming community is blessed with in winter and spring; the muddy road, so-called, tested was a mere hint of the hub-deep mud which real wet weather brings. But even so, the comparison between the best and the worst roads available furnishes food for thought. The differences in total pull on this three-ton load between the near-mud road and the concrete one was 571 pounds, which represents wasted energy—wasted, day in and day out, all over the United States, just as absolutely as though it had never existed. This waste represents no less than 840 per cent of the power necessary to achieve the result, as indicated by the figures for the concrete road. Even making the far less unfavorable comparison with the macadam road—the extent to which road-making progress has attained in many sections—we have a waste of 310 per cent. And no one who has had experience with the honest-to-goodness muddy road in its top form will doubt that for such a road the figures given would be multiplied by at least four or five.

Even to the farmer who does his work with horses exclusively these figures convey grave meaning. No longer is it possible for him to say that his horses do all that he requires, and that that is all they can do anyhow. The day of light use of our roads is gone, never to return. The farmer must, in the regular course of competition, haul heavy loads over the roads to the nearest market. Even if he can convince himself that he is not paying the direct cost of bad roads in horse feed and horseflesh, it must be plain to him that he cannot afford to tolerate a condition that cuts the hauling power of his horses to a third, a tenth, or even a twentieth, of what it ought to be.

Another place where these figures catch the old-fashioned road-maker in a sensitive spot is seen through the very first entry. What man is th[illegible] any experience with [illegible] who has not at some time encountered a stretch of highway — anywhere from a hundred yards to a couple of miles in length —where an economical contractor has dumped a few tons of loose gravel or broken stone, and gone his way rejoicing, leaving it to the long suffering traffic to make his road for him by a tedious process of pounding his stones in and grinding them up? Our California test tells us what we have always suspected—that to drive a load over such a stretch requires about three and a half times as much power as it would on the same road properly finished. Is it any wonder that the farmer prefers, in such a case, to break a new road along the edge of the old one, a road where he can at least hope to get by with an expenditure of 218 pounds per ton and with all his horseshoes or tires intact, as the case may be? Without making any allowances for the great delay in finally wearing the road surface down into respectable shape in this manner, without saying a word about the annoyance of driving over the half-baked rock or gravel road, it must be clear that the actual cost of proper crushing and rolling when the road is first made cannot possibly equal that of crushing and rolling by hoof and tire, with a 350 per cent expenditure of power.



Graphs showing the proper amount of banking with reference to speed and radius of curve

By following along each graph we may read off the speed which is possible on curves of various radii with a bank of ⅝, ¾, etc., inch per foot of road width. The section at the upper left shows the graphs for the area which is blank in the main cut, in which they could not be conveniently drawn to the scale there used.

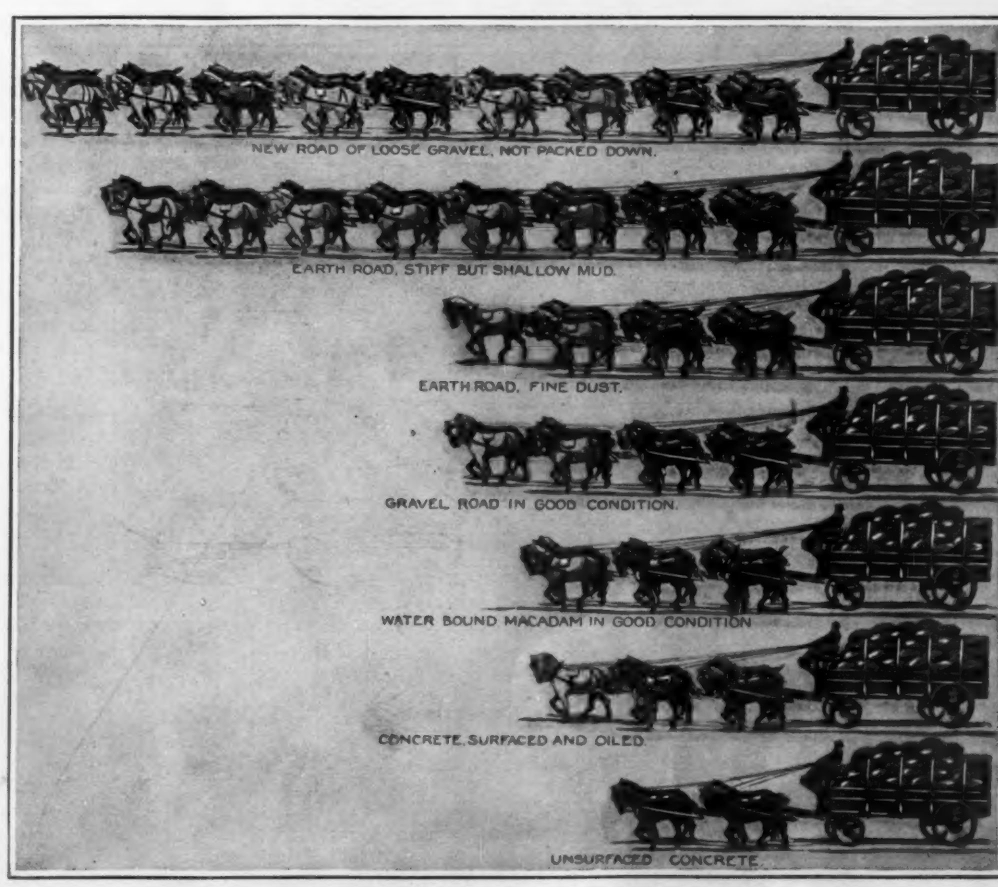
It may cause surprise to many readers to be told that an unsurfaced concrete road works better than a surfaced one. This can only be due to the absence alike of slipping and of sticking; in fact, the natural surface of concrete, if one but has it brought home to him, must really be almost an ideal one for giving just the right amount of friction to make the wheels bite. We would point out, however, that the discrepancy between concrete, macadam and first-class gravel roads is not so great but that any one of the three, under proper local conditions affecting construction and maintenance, might be the most desirable. But the dirt road, on the very face of the returns, is outlawed.

There is one more angle to the roads question as affected by the automobile which we have never before seen brought out. More automobiles mean more speed. The habitue of the race-track and the railroad construction engineer, among others, know that before a curve can be negotiated at speed that curve must be banked—super-elevated, as the engineer has it. They know, too that the degree of banking necessary varies with the speed; that for a given speed, if the path be not sufficiently super-elevated the moving body will shoot off over the top, while if it be too sharply up-tilted that body will fall off in a heap at the bottom. Likewise they know that the sharper a curve is, the more it must be banked.

Certainly the automobilist will see to it that more and more of our roads are so built that a certain degree of speed is safe. This means that more and more of our roads must be banked at the sharp turns. Accordingly the graphs shown in this connection are of interest. They are simple enough to read. Each curve pertains to a certain super-elevation, as marked thereon in inches per running foot of road width. If we wish to know what speed will be safe on a curve of 400 feet radius banked 1 inch to the foot, we have merely to pick out the proper curve and follow it along until it crosses the horizontal line corresponding to the given radius; and we find at this point the vertical line indicatng 22½ miles per hour. Again, if we wish to make safe, for a speed of 36 miles per hour, a curve with radius 800 feet, we follow the horizontal and vertical lines to their intersection, which occurs on the graph for a super-elevation of 1¼ inches—and that is the answer. If we find, in some other case of the same problem, that we are not brought out nicely upon one of the curves given, we can estimate from them what curve would pass through our point. Thus, for a speed of 30 miles per hour on a 500-foot radius, we would have to bank our road a rifle less than 1½ inches per foot. And so on.

The Current Supplement

WITH the current issue of the SCIENTIFIC AMERICAN, SUPPLEMENT, No. 2192, for January 5th, a new volume begins, and the introductory article is *The Cost of Coal*, a subject that is of interest to most people at the present time; and as the paper was written before the stringency in the supply became acute, the facts stated can undoubtedly be relied on more confidently than many of the statements now being circulated. During the past year several portions of a series of articles on *Anomalies of the Animal World* have appeared. Another of these valuable articles appears in this issue, and, as usual, it is excellently illustrated. *Let's Eat Fish* gives a few pertinent facts relating to the fisheries industry that are timely in the present food situation. *The Origin of the Thermionic Vacuum Tube* reviews the history of an interesting device now widely used in radio communication and the electrical arts. The paper is illustrated by a number of explanatory drawings. *The Experience of an Iron Atom* is an interesting story that describes the process of iron and steel in a popular manner that will be found very attractive and readable; and as it is from the pen of a practical man its accuracy is insured. There is a large number of other valuable articles, including *A Cycle in Naval Architecture, Saving Steel in Ships, Eye Protection and Sight Filters, The Tungsten Deposits of Southern Rhodesia*, and *On the Qualitative Separation and Detection of Gallium*.



What the California highway tests tell us about road surfaces

A load that just measures up to the capacity of four horses on an unsurfaced concrete road will require from seven to thirty-six animals, or from two to nine times as much power, on other types of roadway, as shown.

The Nerves of a Soldier

How We Are Organizing a Brand New Service to Make Sure that They Are What They Should Be before We Send Him to France

Some of the Tricks Which the Psychologist Plays Upon the Recruit, as Indicated by the Cuts at the Left and Right

By Annis Salsbury

FLAT-FOOT, subnormal eyesight and other physical imperfections are not the only defects that throw a man out of the ranks of Uncle Sam's Army. The strain of modern warfare is so great that a wide margin of mental and emotional stability is as necessary to endurance in the front trenches as are sound lungs and a strong heart.

The European armies have struggled under an incubus of men of scant mental and nervous reserve. There was no weeding out among the recruits before being sent to the front, and the first fighting filled the hospitals with cases of nervous and mental breakdown. This not only deprived the fighting forces of man power, but it imposed an actual burden upon the army. We are going to avoid this by weeding out, before they are sent to the front, the men who are likely to break under the nervous strain of active service. Attacking the problem are some of the most eminent scientists in the country. They have left University posts, given up practice in big cities, turned the management of hospitals over to their assistants, in order to apply their knowledge to whipping into shape a mentally fit army.

The man in the front trench is stressed from without and within. On the outside is continuous uproar and excitement; inside is the need to maintain a calm and controlled exterior under the most trying circumstances. He cannot get rid of his pent up feelings by engaging in combat with an enemy, for there is seldom opportunity of single combat. The foe is intangible and impersonal; and one can only curse an antagonist who is without shape or place. In addition, trench life forbids the sleep which, to the man at home, gives surcease for another day's struggle. Along with all the unusual experiences of the firing line supervene the irritability and nastiness of temper that follow a night without repose. When at the same time the soldier is probably hungry, cold, wet, and covered with vermin, it is easy to see that he must be a man of first class nerves to meet the situation with success.

A new military arm is being developed which will do its best to help our soldiers in this matter. It will cull out the men who are not built to withstand the nerve stresses of battle. It will throw about the picked men, when first they go to the front, such safeguards as shall minimize nervous troubles. Finally, to those who do break mentally it will give the trained care and treatment that will restore them rapidly to health. Four cantonments are already supplied with experts who are putting into practice the first of these articles; and eventually every gathering place for enlisted and drafted men will have its neurological corps.

The first item on the program of such a body is a wholesale combing for the men of low mentality. This is accomplished by an intelligence test which can be given to a hundred men at a time. The rejects are turned over to the psychiatrist for expert attention. Those who are not malingerers are either actual imbeciles or of such low intelligence that they may only be recommended for certain kinds of simple manual labor under close supervision. Then it is necessary to weed out the kind of man who is brought repeatedly before his company commander for discipline or who, during illness or at some other time, will reveal constitutional nervous weakness. These are the men who will fall out or run amuck on the firing line.

In this work Surgeon-General Gorgas is blazing a pioneer trail. It has been a task of some months to build up a theory and then carry it over into actual practice. The neuro-psychopathic unit at Camp Lee, Virginia, is the first of its kind. Here the equipment is fairly complete and activities are in full swing; a mechanism of procedure has been developed that has run 18,000 men through the mill in two weeks, and that puts the mental examination on a squarely practical basis.

Picture a large room, with 75 or 100 khaki-clad soldiers squatting on the floor, Turkish fashion, with writing boards and printed blanks on their knees. The examiner stands in front with stop-watch in hand.

"Attention!" he sings out; "Make a mark in the largest square of this row of squares. Go!"

This is one of the simplest exercises, which can be done by every recruit who is competent to understand and carry out directions. Similar exercises in this faculty follow, each more difficult, until the last may be something like this:

"Cross out the letter just before C and draw a circle around the third letter before the second K. Go!"

The psychiatrist testing out a suspected malingerer

The group psychological test at Camp Lee

The next test is for memory span. The examiner reads aloud a set of three figures, with the men at attention, pencils lifted from paper. Then they are given a few seconds to write down the set. The numbers increase in length until the last one contains 12 digits. Many have given up trying by this time, and only the memory wizards get the last set correctly.

The test which stumps the greatest number of recruits is that of completing a numerical series. Thus, given the series 31, 28, 30, 27; what number should follow 27 to preserve the law of formation indicated by the part of the series given? This law tells us to subtract 3 and add 2, alternately; so the next term is 29. There is a little trick about this that puzzles the average recruit. For before one can apply the law of formation one must discover what it is; and this requires power to sense relations in abstract. The man who can do this will carry the same power over into realities. He will be able to transfer the basic principles of trench digging from the environment in which he has been taught them, and apply them to any kind of landscape that presents itself.

Other tests follow. Sentences whose words are not in proper order are given, and the men are asked to indicate whether these, if properly arranged, would make a true or a false statement. Arithmetical problems are given which involve little computation but which tax ingenuity. One of several given words must be chosen which will so complete a given sentence that its statement becomes true. A pair of words (like good, bad) must be chosen from a given group which bear the same relation (of oppositeness, etc.) as a given pair (like white, black). The whole thing is over in 50 minutes, the papers gathered and taken to the grading room, and the soldiers returned to their normal camp route—with no weird questions or emotional shocks of any kind.

In another room those who cannot read and write and those who failed in the group intelligence test take the mechanical skill test. This consists of putting together dissembled pieces of mechanism—a bell, a monkey-wrench, etc. If a recruit passes neither test, it is then time to subject him to the recognized procedure of the laboratory psychologist which definitely fixes his mental age and gives a line upon his capabilities. Obviously such a man should not be entrusted with any responsible task such as sentry duty or the charge of a squad; but he may be able to peel potatoes or dig ditches. The psychologist at the end of a two hours' quiz can make definite recommendations.

"The general tests are not finely discriminatory," states the chief pyschological examiner at Camp Lee, "for we are not trying to sort out the aviator type from the artillery man or the signal corps officer from the trench digger. We are merely card-indexing the men according to their mental furnishings. This culls out in speedy fashion the men of low attainment and it is valuable as a basis for promotions, or in the assignment of men to special duties requiring more than average intelligence or mental quickness. The fact that 75 per cent of our judgments, based on the test ratings, coincide with those of the officers who know the men from everyday experience, and that in a specific instance 15 men chosen for promotion by their regimental officers on the basis of daily achievement were the men who made the highest grades in the intelligence test, show how nearly we have hit the mark in making this thing a practical procedure."

It is the psychiatrist who deals individually with the men, and pushes his investigation closely into the details of each case. He takes the men who have flunked the group test and the performance test, gets a line on the subject's past history, and puts him through a few simple tests which show up important nerve reflexes. Most important of all he has a feeling for underlying neurasthenic qualities, acquired by long experience in the care and treatment of the insane. It is he who decides that a big mountaineer who cannot or will not obey the simplest orders is shamming, and recommends him returned to his regiment. It is he who discovers that a frightened Syrian who cannot read or write or march or follow the rapid fire English of the group and individual examiners, but that he is a first-class cook; and accordingly he suggests that the man be referred to his colonel for service in that capacity.

The prophecy is made that, as a result of this work, if the war does nothing else it will remove the stigma that now adheres to various phases of mental trouble. The prevalence of neuroses among soldiers has forced a

(Concluded on page 42)

New Barrel Concrete Mixer for Small Jobs

By Jos. Brinker

THE new type of concrete mixer shown in the accompanying views consists of an ordinary oil barrel, slung in a chain attached to a metal frame in such a way that the barrel is revolved about its own axis, A-B, for mixing. It can be tilted for emptying into a wheelbarrow or other receptacle as shown.

The new mixer is designed for use about the farm or for small contractors' jobs where a large mixer would not be required but where the work done by hand would be costly and slow. The frame is built of angle iron and rigidly braced, yet light and easy to move about.

The machine mixes a wheelbarrow load of about 2½ cubic feet at one time and has sufficient capacity to keep from six to seven men busy to advantage in laying sidewalks, barn floors, culverts, silos, etc. It is operated by a small 1½-horsepower gasoline motor mounted on a flat base or on a small wheeled carriage which makes the device portable. The motor drives through a belt to a pulley on the frame and thence by a sprocket and chain through a pair of bevel gears to the chain wrapped around the barrel.

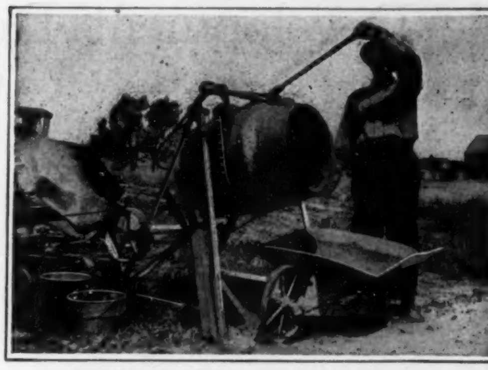
The chain in which the barrel is swung is kept sufficiently tight to have a grip on the barrel by means of two sprockets, each carried on a short shaft supported in a bearing on a short arm extending downward from a pivoted cross member at the top of the A-shaped frame of the unit as shown in the accompanying illustrations.

The chain around the barrel runs over these sprockets, carrying the barrel with it during the mixing operation. The sprockets and the shafts on which they are mounted are revolved by means of a pair of bevel gears on one side of the frame, one bevel gear being mounted on one of the sprocket shafts and the other on a transverse shaft which is turned by means of a second sprocket and chain lay-out from the belt pulley shaft.

The barrel is kept on its true axis of revolution during the mixing operation by means of a bearing pin mounted at the center of the bottom of the barrel. This pin turns in a sleeve carried in a U-shaped rod attached to the pivot points of the A-frame cross member and provided with a handle to turn the barrel over to dump the concrete when mixed.

As shown in the illustrations, the barrel is sufficiently high off the ground to permit the wheelbarrow to be run directly under it so that the concrete is deposited directly into it, thereby saving one shoveling. The concrete in the barrel is always in full sight during the mixing operation so that material or water can be added to the batch at any time.

The barrel is revolved during the dumping operation into the wheelbarrow, this double movement serving to discharge thoroughly all the material of each batch. The barrel is cleaned out for the night by tipping the open end down, washing it out with a stream of water and permitting the green concrete adhering to the sides to drop out by gravity. The frame may be provided with a winch niggerhead for use in elevating the concrete, as when a silo is being built.



Using the barrel mixer on the farm

The barrel concrete-mixer, showing the working details

The Industrial Trackless Train

IN many industrial plants the bulk of goods to be moved from place to place is so great that single trucks are no longer adequate. Accordingly the sight of a train of from five to twenty cars winding in and out through narrow aisles, around corners, among pillars, along floors already congested apparently to the limit of capacity, tracking perfectly and following a miniature self-contained motor-driven haulage unit with no rails to guide them, would greatly astonish the uninitiated; yet this is common in many large establishments today.

The problem of the trackless train presents many interesting features and has given engineers much food for thought. In the first place, the power must come from the storage battery; it would not do to have a miniature gasoline automobile chugging through the factory, adding its problem of ventilation to the other troubles of the manufacturer, and making a total wreck of his insurance policies. At the same time, fundamental requirements are extreme simplicity, coupled with reliability and accessibility; for in case of failure of the machine, it is seldom that sufficient men are immediately obtainable to do its work.

The industrial tractor is intended chiefly for interior work, while the semi-tractor is a heavier and larger machine, capable of yard and dock work and, to some extent, interplant street hauling. The latter, as its name implies, is not a true tractor, as part of the load is supported by the haulage unit, bringing it really in the truck class. The machines in general use are true tractors, varying in capacity from three to fifteen tons under working conditions.

The methods of drive are of interest. The three types commonly found in the commercial truck are all used—chains to jack shaft and thence again to rear wheels, gear or chain to rear axle driving shaft which carries a bevel gear, and the single worm gear reduction. There has been some attempt at four-wheel drive, but it is understood that this machine is no longer manufacturered and with the steering problem what it is, this is readily understandable.

Most of the usual schemes for steering with two wheels fall short of giving satisfaction here, because the wheel base is too great. Consequently, while there is at least one machine made which, by means of a very ingenious multiple lever arrangement, steers satisfactorily on two front wheels, trend of practice seems in favor of a three-wheel truck steering on the single front wheel. This machine is so effective that it may be steered head-on to within ¾ inch of a post and turned in such short radius as to avoid the post, without backing. Another advantage of the three-wheel type is that when lying parallel to a wall, it can be started and turned from the wall without having the rear end slew into the wall.

The trailer equipment for these machines may comprise anything on wheels. When an installation is made it is quite usual to prepare couplings and use the equipment available, and it is seldom necessary to substitute new or special trailers. If necessary, it is even possible to tow wheelbarrows, in trains of almost any number.

The type of hitch often presents a delicate question. Among the hitches already employed are found the cross bar, cross chain, triangle chain, triangle bar, double triangle, both bar and chain, and various more or less automatic hitches. One automatic coupling is offered which will take hold through a considerable angle and whenever the trailers are not more than 3½ inches out of line on either side of the center.

The draw-bar pull necessary to keep a train of these trucks moving will average about 65 pounds to the ton, trailer and load, on a concrete floor. Roller or ball bearings will decrease this, less favorable surfaces will increase it; in particular, for each one per cent of grade it will go up 10 per cent.

Two cases may be cited to show the savings effected by these tractors. One machine installed with the idea that it would pull six or eight cars, is hauling from 19 to 22, doing the work of 13 men; and when an incline leading to the street is completed several more men and a power conveyor will go into the discard. At a certain mill in the Middle West, in addition to this direct economy, notable results have been achieved in the way of simplifying the rehandling of material. With the machines that carry on the successive operations of manufacture arranged strategically, the tractor keeps a continuous series of trailer trains in motion, dropping one train at the first machine, picking up the train left here on the previous trip and moving it to the second station, and so on to the packing room. Not only is the operation of returning empty for a fresh load thus eliminated, but the material is kept on wheels and moving through the shop at maximum speed.

Three-wheeled tractor taking its train around a corner

The four-wheeled type at work on a railroad platform

Pipe Lines for Bringing Oil from Roumania

A WRITER in the *Rheinisch-Westfälische Zeitung* of September 18th, 1917, complains that Germany does not seem to be any better off from having captured the Roumanian oil fields, so far as the supply of oil for domestic use is concerned. The shortage of petroleum is as serious as at any time since the start of the war.

It has been estimated that there are about 700,000 tons of petroleum and its various distilled products in Roumania at present. The cost of transportation in privately owned tank cars would be about 147,000,000 marks (35,000,000 marks would be for freight and the remainder for rent of oil cars). Cars that before the war could be rented for a whole year for 300 to 400 marks now cost from 1,600 to 2,400 marks for a single round trip to Roumania.

It may be estimated that a pipe-line (eight-inch) from Ploesti, via Predeal, Kisuyssallass, and Kiskernye, to Oderberg (a distance of 1,200 kilometers) would cost about 15,000,000 marks. Of course, it is impossible to estimate the cost of the pump stations, of which there would have to be a great number. It may be estimated, however, that the cost of transportation would be about 50 marks per 10 tons, instead of 2,100 marks, the present approximate cost.

Automobile Development During 1918

A Review of the Year's Progress and Prospects for the Immediate Future

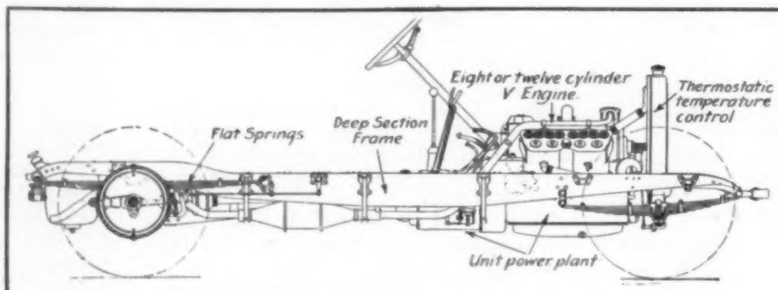
By Victor W. Pagé, M. S. A. E.

IT has been customary in the past to discuss in these columns the developments that have been made and that were contemplated in automobile design and the subject has usually required considerable space to present adequately. During the past year the energies of automobile engineers have been occupied with problems of much greater national importance than the evolving of new types of engines or the making of radical changes in trucks or passenger cars. It has been predicted in these columns that sooner or later the various types of motor vehicles would be perfected to such a degree that there would exist but little opportunity for making any radical changes in design or construction methods. The writer believes that even if the present world war were not foremost in the minds of our engineering experts there would be but few changes to chronicle in motor vehicles. The types of 1916-17 were the result of several years' evolution and the question of design has settled to several sharply defined types which can not be excelled for the specific character of work they are intended to do.

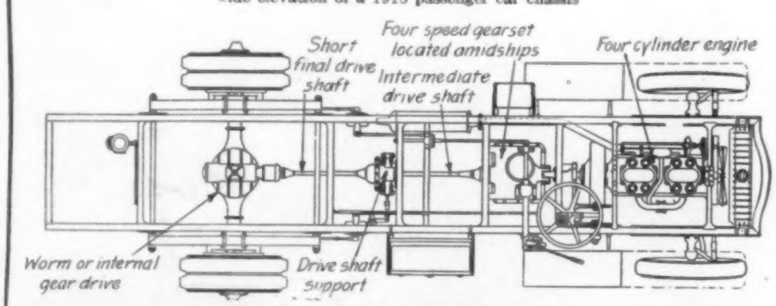
Automobile engineering during the past year has been developed along two main lines, neither of which would call for any radical changes in the design or arrangement of the motor vehicle components. The first of these, economy of maintenance, obviously could be obtained by slight refinements of detail while the second and perhaps most important, that of greater endurance and reliability called for a revision in methods of manufacture only and in a careful selection of materials that would be affected but little by changes in vehicle design. The developments of the past year have been conspicuously few compared to the improvements that were made in previous years.

Among the problems to receive serious consideration have been those making for economical operation through efforts to utilize hydro-carbon fuels of low volatility such as distillate and kerosene. The carburetion problem has been a serious one as the grades of gasoline which are now available are considerably lower in test and are depreciating more and more as time goes on. If the automobile designer of a decade ago had been told to build an engine capable of utilizing the grades of fuel marketed today as gasoline, he would have found the problem almost impossible of solution, because all of the engines built in the early days were designed for use with fuels that evaporated rapidly at ordinary temperatures. The changes in engine design, by which it is possible to use the heavier grade fuels have been made so gradually that they have escaped general observation. A brief consideration will be given, in proper sequence, of the various methods by which engineers are able to secure reasonably good operation on low grade fuel. Another marked development is the use of extremely large pneumatic tires for heavy capacity trucks. It is not unusual to find pneumatic tires on commercial vehicles of one ton capacity and several makers made a practice of fitting them to the front wheels of vehicles of 3,000 pounds capacity. Tires of 12-inch cross-section have actually been produced and used on rear as well as front wheels of 4-ton trucks while 9-inch tires are in regular commercial use in heavy express service. This tire development is due to the research of one of the leading tire makers which has been endeavoring to surmount some of the practical problems incidental not only to the manufacture of large tires, but also to their practical application in a field where tire upkeep is a very important item in operating costs.

Solid tires have been used on heavy, slow speed vehicles because it was found that these gave extremely good mileage and also that they were considerably more reliable than pneumatic tires. In an attempt to use pneumatic tires on trucks some designers had provided special rims that were capable of carrying two and in some cases three tires of standard size in order to obtain the required carrying capacity. It was argued that if one of these tires became punctured the load would be carried by the remaining casings, but in the case of the twin pneumatic tire the remaining tire was so greatly overloaded when called upon to carry the load that should properly have been distributed on two, that it depreciated very rapidly in service and was apt to burst. The pneumatic tires of extremely large size and having very thick walls and substantial treads seem to give much better satisfaction than the use of two or three tires, as the extremely heavy casings cannot be punctured by objects that would easily penetrate the thinner, standard size passenger car tires which were not designed to endure the rough and grueling service that motor truck tires of the present day are subjected to.



Side elevation of a 1918 passenger car chassis



Plan view of a 1918 motor truck chassis

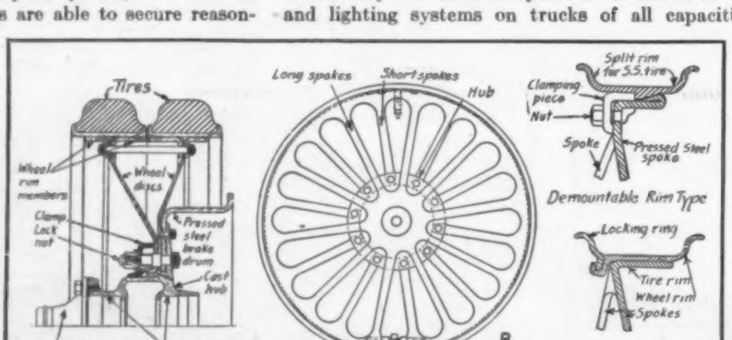
Variations in practice between passenger and truck design

While electric starting and lighting systems have been considered indispensable in pleasure car service and practically all cars that have been offered for several years past have included electric starting and lighting equipment, the makers of trucks have been slow to adopt this very necessary and important refinement of detail. It was contended that the increased complication of the truck mechanism, if electrical apparatus other than that essential for ignition purposes were fitted, introduced an item of unreliable action that could not be countenanced in a business vehicle. Time has proven that this claim is uncalled for, and the very satisfactory and reliable operation of electrical starting and lighting systems on trucks of all capacities has created a demand on the part of the business men for a more complete electrical equipment. The specification of electrical lighting on some of the government truck purchases intended for war work is sufficient evidence that a properly installed electrical system is just as necessary on a motor truck as it is on a passenger car. The only thing to consider is to install the parts in a more substantial manner than is usually followed in passenger car practice. It is not only important to be very careful in making the installation, but the electrical apparatus itself must be of especially rugged character to withstand the jarring and jolting that the mechanism of the motor truck is subjected to. Delicate voltage regulators that have given very good service on passenger cars were found to be poorly adapted for truck use; so after the units of the electrical starting and lighting system had been strengthened and simplified no further trouble was experienced, and the systems did their work just as efficiently on the heavy duty vehicles as on the lighter passenger cars to which they were first fitted.

Another tendency in connection with the transmission system is toward the general adoption of speed change gearing providing four forward speeds and one reverse on trucks of even moderate capacity. For a time it looked as though the unit power plant was to be the accepted type for all classes of motor vehicles, but it was found that in trucks of long wheelbase the mounting of the gear box as a unit with the power plant, called for the use of long driving shafts which were subject to "whipping." Wherever a unit power plant is used, at the present time, on a long wheelbase chassis there is always an auxiliary device or ball bearing supporting member attached to one of the cross members of the frame, so that the driving shaft that is unsupported will be as short as is consistent with good design. The use of the supplementary bearing on the frame cross member could be done away with by placing the gear box amidships instead of combining it with the engine. This practice is more desirable on trucks than on pleasure cars, where the other system is practically universal because a four-speed gear box that is strong enough to handle the loads imposed in moving a heavy truck is considerably too large and heavy to be combined advantageously with a unit power plant. This explains why a method of construction that is universally used and that is extremely practical for passenger cars is not so well adapted for trucks of large capacity.

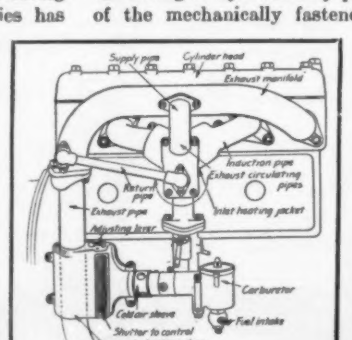
In connection with truck design one of the important events of the past year has been the combined efforts of leading engineers coöperating with army transportation experts to design several types of truck that were intended to incorporate the best features of modern truck practice in an effort to devise standard types that could be produced in enormous quantities for war work. If the standardized truck stands the test of war service, and there is no reason to doubt its capacity for heavy work, it may produce an effect on engineering progress in times of peace as related to truck design. As these trucks have just entered the production stage it is too early to prophesy just what influence the standardized truck will have on automobile engineering of the future.

Among the minor design tendencies noted are the use of metal wheel in both the disk and the cast steel form, the fitting of hydraulically pressed-on solid tires instead of the mechanically fastened demountable type that seemed to increase in popularity in times past. The enclosed form of drive gearing has now almost entirely superseded side chain driving system and practically all of the 1918 trucks are to be driven either by worm, internal gear or double reduction live axles. The Government standard war truck uses entirely enclosed drive gearing.



Some types of steel wheels now in use

A. Built up wheel for a heavy truck. B. Design for light cars adapted for pneumatic tires and two forms of rim suitable for use with it.



Carburetor for low grade fuel

Conventional arrangement by which exhaust gasses heat the induction pipe

The Hotchkiss Drive had been looked upon with suspicion by engineering authorities interested in the design of heavy duty vehicles. The experience of the past year has demonstrated that this system of power transmission, which eliminates radius rods or separate torque members by using springs of sufficient strength to carry the driving and braking torque reaction and also to transmit the propulsive effort to the vehicle frame, materially simplifies the chassis structure and is absolutely dependable.

The greatest problem yet to be solved by automobile engineers is a carburetion system that will utilize the kerosene or the gasoline sold today which is so heavy that it has many of the characteristics of kerosene. If one attempts to use an ordinary carburetor with a heavy fuel, even though it is possible to run the engine after a

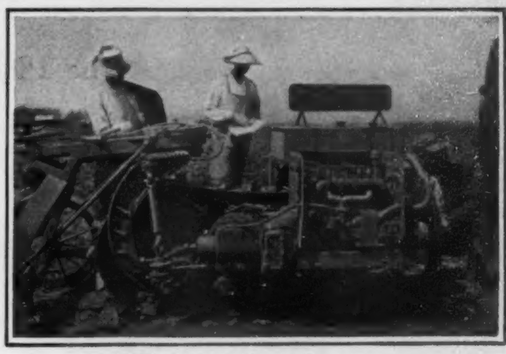
(Continued on page 48)

The convertible car

The Gasoline Horse In The West

Tractors and Tractors and Then Some More Tractors; How Their Value for Farm Service Has Been Demonstrated in California

By Edward C. Crossman



The one-track crawler type

HAY—at the writing of this story—costs $26 per ton in California. Gasoline costs 20 cents per gallon, distillate 11 cents, kerosene 10 cents.

Also there be valleys in California and in other states of the great southwest, where the horse—the $26-per-ton-hay horse—works at half efficiency, with heaving sides and dripping flanks, during the hot months of the summer

Wherefore the raising into place of gigantic tents until the appearance of a three-ring circus was accurately presented, and the assembling of scores of tractors and then the gathering of more than sixty thousand interested persons, mainly of bucolic persuasion, at the Vail Ranch, near Los Angeles, to watch the marvels of that newly-come animal, the gasoline horse, actually at work. Five thousand automobiles were parked in one grand aggregation the last day of the five-day demonstration; twenty-five thousand persons were on the ground the last afternoon. The California rancher has arrived at the realization of the fact that the tractor is no longer a machine for the big ranches—it may come between him and failure if the war runs on into the years.

War has put the good farm horse up into the $200 class, nor does the end of the war, whenever that may be, promise speedy relief either in feed bill or horse prices. Most of the horses, gone from our ranches and farms, won't come back. The gasoline motor has climbed the fence 'twixt road and field and has settled into the collar of Dobbin for good.

No law is there to compel the tractor to do most of its buzzing and clanking west of the Missouri, but it is west of the Missouri that it promises to come into its fullest usefulness. For instance, in southern California there used to stretch a dismal desert waste from the eastern base of the San Jacinto range nearly to the Colorado River. A salt lake lay in its center, far below sea level. The pioneers staggered across its sizzling white reaches, as they crossed those of Arizona, dazed with mid-summer heat, carrying their scanty store of water from one infrequent water hole to the next—sometimes never reaching the next. Only, it wasn't really a desert, it was a stretch of as fertile soil as lay in America, the silt of the great Colorado that used to empty into the basin, but still devoid of water and long on sunshine and heat.

Today, after seventeen years settlement, the Imperial Valley raises annually $30,000,000 worth of crops. Forty-five thousand people live there. The brown waters of the Colorado have been turned into the valley. But the desert heat still remains, and work during the summer months is a matter mainly of the hours before ten in the morning, and after four in the afternoon. The horse is seen at his worst under such conditions.

To the early part of 1916 the tractor was unknown here. Then one of the ranchers, visiting the Panama-Pacific Exposition, became impressed with the tractor idea and shipped one to his ranch, a 10-20 horse-power wheeled machine. That is, just a bit more than a year ago, the tractor was an experiment in this great farming valley, outside of the great track-laying machines on the big ranches.

Now there are at least four hundred in the valley. They are steadily displacing the horse. The soil is devoid of stones, making it peculiarly suited to the tractor, while the ability of the machine to work at its maximum power regardless of heat puts the finishing touches on Dobbin.

Using powerful automobile headlights the ranchers of the valley dodge the hours of heat and extend the working day by ploughing at night. The visitor is puzzled to grasp the reason for the flashes of bright white light out where there are no roads, and for the chugging of engines where he knows there stretch only the long reaches of ranch fields.

Now, despite the broiling sun, the buzzing, smellful monsters pull ploughs and cultivators and mowing machines, headers, binders and road scrapers. They drag ditch-cleaners, an important job in the district dependent on the silty water of the Colorado, and they pull out stumps here and there, and they drag weed-clearers and brush-levelers, to say nothing of stretching barb-wire, a typical western job. Sitting still, the tractor does all the tiresome stunts that fell partly to the horse and partly to the hired man, from cutting ensilage, sawing wood, hoisting hay and baling it, to grinding the axe.

The tractor of today is not at all the tractor of last year. Its devlopment—retarded by the idea that it was some kind of automobile with the ability to get along with automobile equipment—has been more rapid during the last two years, than that of the motor car in five. This has been due merely to the recognition of the peculiar problems to be met, and the sensible solution of them. The tractor-building enthusiasts gave over the idea of the high-speed motor-car engine; they found that the unprotected carburetor of the automobile eventually put more dust than gas into engine cylinders. Simplifying the mechanism has made the machine cheaper and made it possible for the farmer to run it. If the long-promised cheap tractor of the "dove of peace" variety is as cheap and as efficient as we're told it will be, the tractor will even clank merrily around the little farm of the two-horse farmer, unable now to afford such a machine. A tractor for $250 will revolutionize American farming. Doubting the appearance of such a machine, consider the $360 automobile, with us to the number of 1,500,000.

Hand cultivator, with motor inside the wheel

The successful tractor of 1917—in which year some 70,000 tractors will have been built—seems to be standardized by the installation of a simple, sturdy, low-speed motor, not at all of the automobile type. A standard and successful machine shown at the Los Angeles show uses nothing more than a plain, sturdy, two-cylinder motor of marine type, with the economy and the simplicity of that type of motor. From 350 to 700 revolutions per minute seems to be the rule. Geared as they are, around 40 to 1, high speed in the motor is neither necessary nor desirable, as the tractor speed runs from 1½ to 3 miles per hour. Simplicity, good cooling, good lubrication and sturdiness have to be found in the successful tractor motor, because in the things it is called on to do it puts the motor of the hardest-worked automobile to shame.

Because of the reduction in gear ratios, necessary to get power and flexibility, the tractor engine may make from 20,000 to 25,000 revolutions per mile, against perhaps 2,500 for the engine of the automobile. According to the engineer of one big tractor factory, the motor of a tractor used steadily for 100 days, turns over as many times as that of a car driven 25,000 miles! Wherefore the necessity for light and careful use of the tractor for the first week, until it has been "worked in," and then the systematic attention to its "joints," where lubrication is called for.

The tractors of 1917 represent the ever-growing argument between the wheeled type and the now famous track-laying sort. These were seen at the Los Angeles show in about equal number, in the forty-odd tractors there exhibited, and their makers were equally vociferous and insistent in their claims of type superiority.

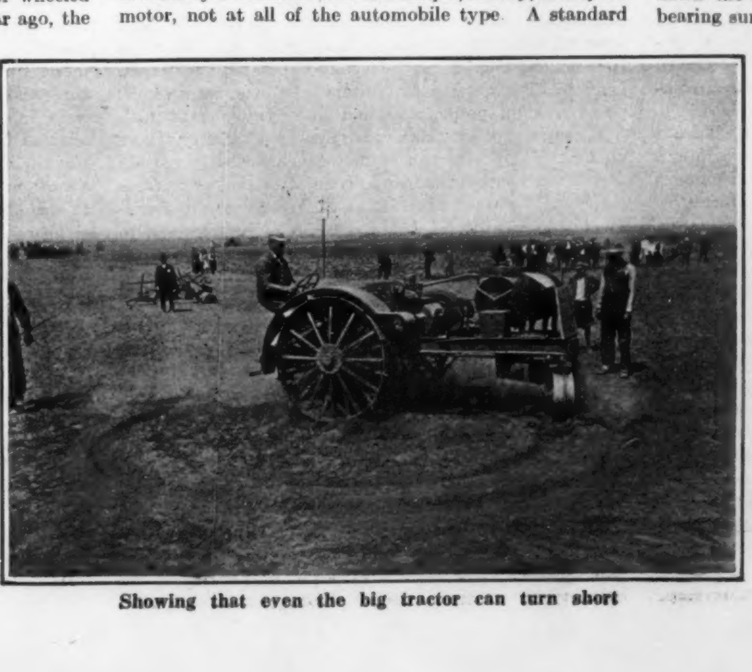
Roughly, all tractors can be classed as one or the other —wheeled or track-laying, although in both cases there are small departures from the true type. For instance, at the California demonstration there chugged along a veritable gasoline horse, having but two wheels instead of the customary three or four, and controlled from the seat of the implement being hauled. With this two-wheeled tractor, the farmer did all the work from the seat of the tool, driving the machine as he'd drive a horse, while the other, more common types, required a "chauffeur" for the tractor and under some conditions another man for the tool. Also the makers of this machine claim for it greater tractive power for its weight, because the weight is concentrated on the two wheels instead of on three or four, of which only two exert tractive effort.

The famous "tank" of the British, so much portrayed in still and moving pictures, makes the track-laying type of machine familiar to the American public—particularly to the readers of the SCIENTIFIC AMERICAN; but what is not so well known is the fact that there are a half score or more farm tractors now being turned out by as many different companies with this type of running gear.

For farm use its advocates claim that it does not pad down the soil because of the great area of its weight bearing surface—600 square inches or more, and that it can go anywhere without turning over or sinking beyond its power to extricate itself, while the wheeled type will turn over on a hillside and the wheel will pack down the ground to the harm of the crop therein —or to be in.

To this the wheeled type makers reply that the track of their rival machines does just the thing the machines are alleged to avoid—that the track nicely packs down the ground and leaves it packed, while the "grousers," the formidable looking blades on the wheels, tear up the ground as the wheel leaves it, as the paddles of the steamer lift the water with them as they leave it. Also they point out the historic test with the egg that was buried six inches under the surface of soft ploughed earth and run over with a big wheel tractor without being broken. It is of course true that an egg is not so easily broken as the layman thinks when put under steady pressure.

While the writer does not pretend to be able to judge as to the merits of the two



Showing that even the big tractor can turn short

(Continued on page 44)

Looking Forward

The Place of the Automobile in the Years to Come

By John R. Eustis

IT is twenty-two years ago, almost to a day, that the first sale of an automobile was made in this country. In this, as well as in experimental progress, Europe, particularly France, the birthplace of the gasoline car, was at that time a year or so ahead of the United States. Today, out of about five and a half million automobiles of all types in use throughout the world, four and a quarter million, or 77 per cent, are within the borders of the United States; one to every 24 of our population, one to every fifth family. This service, largely utilitarian, is now warp and woof of our national existence, commercial and social, interwoven into every sphere of our varied activities.

And in these 22 years the industry which produces the automobile has grown from nothing to the third largest in the country, ranking next to steel and railroads. It employs, in the automobile factories proper and in accessory and parts manufacturing, a total of 600,000 workers. With a capitalization of $736,000,000, the automobile makers do an annual gross business of of $917,470,938. About 27,800 dealer units are engaged in marketing the products of the automobile factories, representing a further capitalization of approximately $184,000,000 and the employment of an additional 230,000 wage earners. Then there is the tire-manufacturing business, which produces eighteen million tires annually, worth $450,000,000. On the basis established by the Government Census Bureau, of four and a half adults and children in the average American family, nearly five per cent of the population of the United States is now dependent on the automobile industry for its living.

Measured in terms of service rendered, 4,000,000 passenger cars averaging 5,000 miles a year and three passengers each, give a total of 60,000,000,000 passenger miles. At two cents per mile this service is worth $1,100,000,000 annually. The figures for railroads are 35,000,000,000 passenger miles, worth $700,000,000. In 1912 the electric traction roads carried 12,135,000,000 passengers, and an average of a three-mile ride—no experts place a higher figure—would give a passenger mile service equal to that of the railroads. No one questions a continuance of the growth of railroads and electric traction lines, or an ever increasing extension of their valuable services. Then how can anyone question a continuance in growth of motor travel, now almost equal to railroad and traction travel combined?

Not the least of the after-effects of the war will be a stimulation of motor travel and motor transportation. The extensive, varied and highly successful employment of all types of automobiles by all the military forces involved, and in every part of the world where fighting has taken place or where troops have been mobilized and trained, has paved the way for a similar widespread use in commercial activities.

Consider this influence in the United States alone. With hardly an exception, the big factor in the construction of the National Army Cantonments and other camps has been the extensive use of motor trucks and passenger cars. Our army is securing motor vehicles by the tens of thousands and will be the best motorized army of all. The acute railroad freight situation, especially in the Eastern States, has given an impetus to inter-city motor transportation, a field in which the motor truck has more than made good. Having thus demonstrated its worth in war emergencies will the motor vehicle not thereby benefit after the war?

Again consider Africa, a continent of vast undeveloped resources, undeveloped because of inadequate transportation facilities. Before the war it was progressing slowly, as must be the case where railroads are the accepted means of transportation. To be sure, automobiles had gained a foothold there and were increasing in numbers against heavy handicaps of bad roads, high cost of fuel and severe taxes, the last the result of hostile prejudice. With the very start of the war came the De Wet rebellion which was crushed in two months by troops traveling largely by automobile, all motor vehicles in South Africa having been commandeered for the purpose. Then came the subsequent campaigns in which all of the German possessions in Africa were captured and in which motor vehicles of all types were used on a large scale, performing transportation tasks theretofore deemed impossible. With such a demonstration of motor vehicle capabilities under their own unfavorable conditions, will not Africanders avail themselves in full measure of the benefits of motor travel and motor transportation, devoting their energies at least as much to highway construction as to railroad building? And, as initial and operating costs are far less and flexibility far greater, will Africa not develop much faster than was the case, for example, with the western part of the United States which was developed by railroads?

Two large trucks in regular service between Boston and Akron, Ohio, mounted on 9-inch pneumatic tires

Train of 3-ton trucks loaded with government supplies, on a test run from Detroit to the Atlantic seaboard

It is much the same in Egypt, in Palestine, in Mesopotamia, along the northern frontier of India where automobiles have been seen for the first time, in Macedonia where the Allied army has built several hundred miles of good roads, in Bulgaria and Turkey as the result of German initiative, and in European Russia. Even in Europe itself, military use has shown new possibilities in motor travel and motor transportation.

There is another war condition which directly favors an extension in the use of motor vehicles, a condition which will continue for some time after the war. This is the world war shortage of food. According to Government statistics, it requires five acres of tillable land to feed a horse or mule each year. If the 4,000,000 automobiles in the United States replace on an average of two horses, then they release 40,000,000 acres of tillable land for raising food for human consumption. This acreage, again by Government statistics, will feed 12,000,000 people annually. Here is another reason why the number of motor vehicles must increase.

This same condition of food shortage is bringing a tremendous increase in the use of agricultural tractors, a type of motor vehicle which represents the same high efficiency in its field as do the motor truck and passenger car in theirs. In 1916 there were built in the United States 39,000 of these tractors. In 1917 the production was about 50,000 with an estimated demand for double this number, which could not be met on account of the scarcity of materials, labor shortage and congested shipping conditions. Within a few years there will be something like a million agricultural tractors in the United States, costing their owners approximately $1,000,000,000.

Under direct government aid, agricultural tractors have entered upon widespread use in England and France and in the case of England a ten per cent increase in crops this year is attributed largely to their use. The world's largest builder of automobiles is now building tractors for the British Government and will have delivered 6,000 by April 1st. Then he commences delivery of an order for 8,000 for the French Government. He is further building a tractor factory in Ireland. And months before he received these foreign orders, he confidently predicted that within a few years his tractor business would be larger than his automobile business.

This leads us to the fact that the manufacture of agricultural tractors is already a definite branch of the automobile industry. A score of well-known maker, of automobiles are experimenting in this field and will soon have their new products on the market. The agricultural tractors already in use in this country, with perhaps a few exceptions, have needed two things badly—application of the engineering skill of the automobile industry to their design and construction, and the kind of service facilities which the automobile dealer already offers his customers. A recent canvass of the present agricultural tractor manufacturers showed them almost two to one in favor of the automobile dealer against the implement dealer as the better distributing agent.

There is another field in which the automobile industry has a bright and potential future and that is in aircraft production. Even today the building of aircraft is largely confined to the automobile industry, particularly in view of the fact that the principal exclusive builders of aircraft are owned by or affiliated with automobile companies. The Liberty Motor is largely the product of automobile engineering skill and most of the tremendous aircraft equipment our government is acquiring is being made in automboile and accessory plant.

Tremendous progress will be made in aerial travel and transportation when the facilities, energies and skill now being devoted to making aircraft efficient instruments of warfare are turned, after the war, into commercial lines. Flying has advanced further in the past three and a half years of war than it would probably have done in 20 years of peace. Aircraft are now further advanced than were automobiles of 15 years ago, and when peace comes mankind will have at its disposal a new mode of travel and transportation and tens of thousands of trained aviators.

There is another field, representing a comparatively new and very extensive market for automobiles of the passenger car type, particularly in the United States. This is among the working people, especially the ranks of skilled labor. Because of the marked increase in their earnings, these workers are now, as a class, prospective automobile owners. Again, the market for passenger cars will be directly increased by the new basis of sales argument now being established in the automobile business, also as a result of war conditions. The change is marked by the substitution of the term "passenger car" for "pleasure car", with all that this substitution signifies.

In considering the future market for automobiles we must not loose sight of the fact that it will require at least 600,000 vehicles a year to maintain the number now

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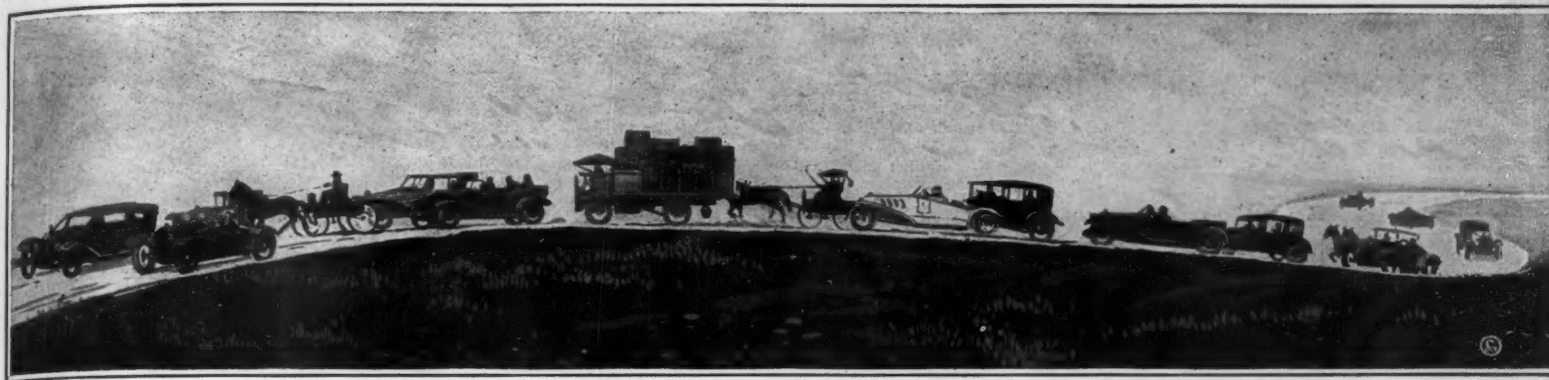

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For every freight carrier that passed the test point near Ames, Iowa, there were sixteen vehicles whose primary purpose was to carry passengers

Iowa's Traffic Census and What It Teaches

A Novel Undertaking Which Eliminates Guesswork as to How and by Whom Our Roads Are Used

ON another page we present facts and figures designed to bring out more clearly than has been brought out before how very expensive poorly located roads and poorly constructed roads are from the point of view of the man who has to produce power for use on them. While we have tried here to throw light upon the subject from a rather novel angle, the abstract point itself is far from a new one; it is in degree, rather than in kind, that there can be any diversity of opinion as to the cost of bad roads.

Nevertheless, we have bad roads; and the question is therefore a pertinent one why we have so long tolerated them. An answer is fairly simple; the bodies in whose hands have rested matters of road policy have felt, and their constituents have agreed with them, that while perhaps good roads would constitute a national economy, they would not constitute a local economy. The idea has prevailed that the cost of building good roads is greater than the saving which they would effect for that part of the community which would have to pay for them.

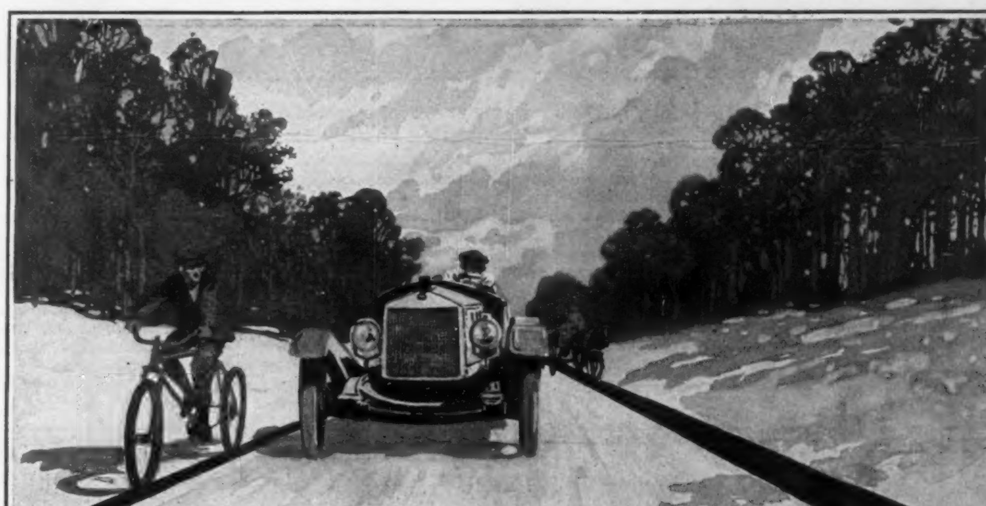
It seems that this good old argument in favor of bad roads will never down. We have all heard it insisted upon vociferously that good roads are demanded only by the tourist, who wants them so that he can shoot through the country in his high-priced car; and that accordingly the farmer and the small city merchant are wasting their good money when they put it into highway improvement. Of course the lessened cost of transportation is felt by all classes in proportion to their use of the roads; but the argument runs that the tourist and his ilk use them so much more than the farmer and the other classes of local traffic that better roads are altogether a one-sided game.

Now argument is the easiest thing in the world when one is not tied down to the facts in the case; and if these have never been determined, of course every disputant will make them up to suit himself as he goes along. But in the present instance he will no longer be able to do this. Just as the man who advocates good roads from the one angle can point to supporting data from California, so his colleague who argues from another standpoint can now quote Iowa figures to show that it is not the tourist who reaps the benefit of good roads. For what the makers believe to be the first exhaustive analysis of country road traffic has been made during the past summer by the Engineering Experiment Station of Iowa State College, with the coöperation of the State Highway Commission. This traffic census was taken through periods of from seven to ten days at a number of typical points on well traveled roads.

The engineering students who did the work set up scales covering half the width of the road at each counting station. A huge sign across the road announced the purpose of these, and the driver of every car was halted and interrogated. Among the statistics gathered were total number of vehicles, character of traffic (whether farm, interurban or tourist), percentages of horse-drawn and motor vehicles, tonnage of the traffic, width and character of tires, etc.

The results of this survey are illuminating. At a carefully selected point near Ames, on the Ames-Des Moines road, there passed, during ten consecutive days of June, 1995 vehicles, carrying 5,561 passengers and weighing 4,919,456 pounds gross. Of these 647 were classified as farm traffic, 1,227 as interurban, 121 as tourist. The exact basis of the distinction between farm and interurban business is not set forth, and in any event it is clear that a good deal of discretion would have to be exercised here by the enumerator. But most of the interurban traffic will have a close connection with the farm, either originating there or terminating there or, as in the cases of mail driver and retail delivery truck, doing business there in passing; and especially will this be true when we reflect that from this sample of interurban traffic the railroading commuter is eliminated. Taking the figures at their face value, we see that at the very worst, 32 per cent of all traffic is indentified indisputably with the farm, while at the very best 94 per cent is in a class which pertains to the farm and the nearby town, and which is accordingly of a local character within the county or perhaps within several adjoining counties. The true figure for traffic definitely tied up with the farm in one way or another would of course lie between these two, but would certainly come far closer to the high one than to the low one.

Moreover, the location of this test, on the direct road to the capital and metropolis of the state, and in a country peculiarly rich in urban development, was certainly not one in which we might look for an especially favorable showing by farm traffic; and the season of the test is one in which that traffic is at a low ebb—the farmer has got all his supplies in, but has not begun to ship his products out, while he is altogether too busy with other things to go driving about the surrounding country just for the fun of it. And on the other hand June is a month in which tourist activity is just coming into its own after the long hiatus of winter and early spring. On the basis of these figures, it must be very plain that the great bulk of traffic on our country roads is farm traffic, while an even larger preponderance is local in its nature.



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The widths of the three lanes into which this road is divided show the proportion between motor, horse-drawn and cycle traffic on one of Iowa's main highways

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The same traffic was classified into tourist, interurban and farm in the proportions indicated by these figures

While the distribution of traffic between these three heads is perhaps the most interesting of the undertakings made possible by the Iowa road census, the data here compiled will settle a lot of other outstanding questions, and perhaps make a few points which will be entirely novel. The fact that of the 1,995 vehicles 1,752 fell in the class of motor vehicles and bicycles while but 243 were horse-drawn emphasizes what we have already known about the great inroads of the automobile, though we must admit that there are many sections of the country where this percentage would have been materially altered. The division of these motor vehicles into 1,394 touring cars, 213 roadsters, 59 motorcycles, 41 bicycles, 44 motor trucks and 1 tractor is of interest as throwing light upon the habits of rural and suburban motorists. It is perhaps not superfluous to point out that the 121 tourists' cars might well be deducted from the total of

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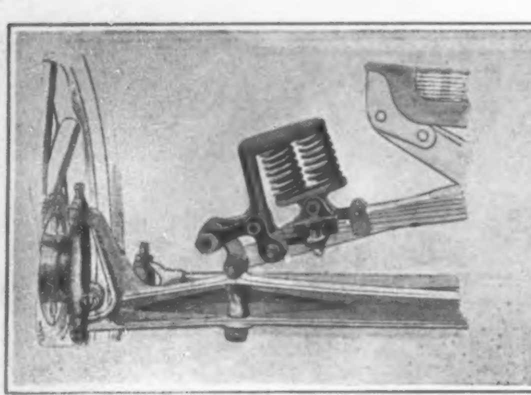
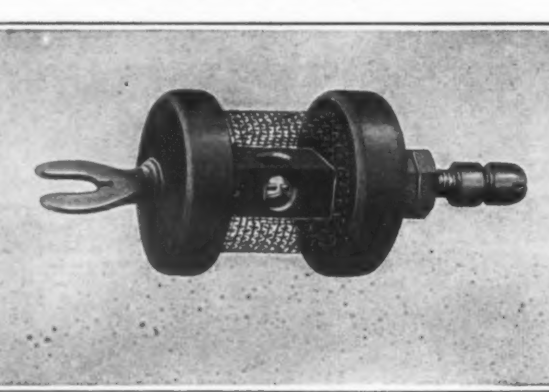


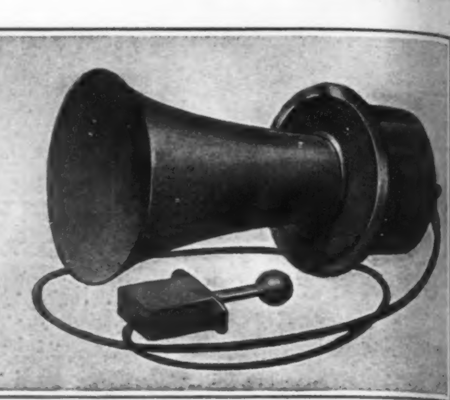
Taking the jar out of the small car

If shock absorbers have a place on the large, heavy car, there is all the more reason why they should be used on small, light cars. Fortunately, there is almost no end to the shock absorbers available for the small car, and, being simple and in most cases of the spring type, they are inexpensive and well within the reach of the owner of a low-priced car. The one shown in the accompanying illustration is typical of most light-car shock absorbers. It is of the twin-spring design, so arranged that the jar from the road and the recoil of the car springs are taken care of in turn. This shock absorber is readily applied to front and rear springs.



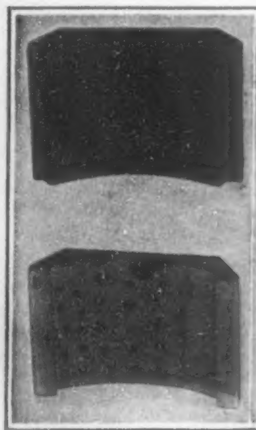
Keeping spark plugs in firing order

To paraphrase a well-known saying, it may be said that "An automobile engine is no stronger than its weakest spark plug." Which means that the spark plug is an important factor in the satisfactory operation of the motor car. To this end there have been introduced several spark plug devices among the season's automobile accessories. Most of these devices take on the form of auxiliary spark gaps, connected in series with each spark plug so that the working of each unit can be noted at a glance. Furthermore, if any spark plug should be short-circuited, the auxiliary gap prevents the circuit from being short-circuited and so effecting the ignition system in general. The present spark plug device has an adjustable gap which is enclosed in a gauze screen, just as in the "safety" lamp for miners.



Operating the automobile horn at a distance

The last word in automobile horns this season is a cable-driven model. Whereas with the usual hand-operated horns it is necessary to place them within reach of the driver, in the present model the horn may be placed anywhere under the hood or on the dash, while the hand-operated plunger is mounted on the steering column or at the side of the driver. In brief, the cable-driven model has all the advantages of the electric model. The hand-plunger and flexible cable are readily installed and do not take away from the appearance of any car. The horn emits a strong warning signal, and the sound may be varied by the pressure exerted on the plunger.

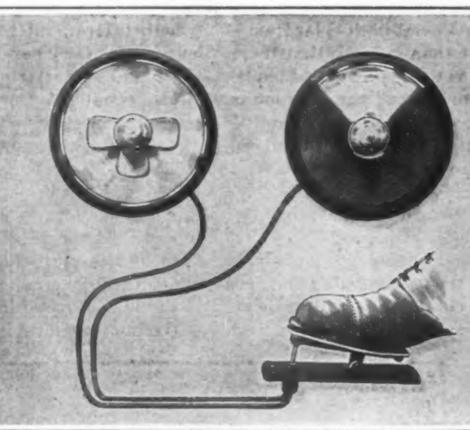


Brake shoes of metal

Not unlike the brake shoes of trolley cars and steam trains is the new brake shoe just introduced for use on motor cars. In the accompanying illustration appears the new brake shoe as it comes from the foundry, and the same shoe after it has received the molded graphalized-asbestos material face to form a friction surface for heavy duty service on cars or trucks.

A long-handled jack without pawls or ratchets

Designers and manufacturers of automobile jacks have finally decided that the right kind of a jack is one which can be operated at some distance from the grease, dirt and mud of the car; in other words, the driver should not be obliged to ruin a suit of clothes every time it becomes necessary to use a jack. So among the present offerings we find a long-handled jack which is operated merely by turning one way for raising the car, and by turning the other way for lowering it. There are no kick-backs or blows from the handle as in the old-fashioned jacks when the ratchet does not catch. There are no ratchets or pawls in this jack, and consequently it is simple, yet positive and dependable. Any boy or woman can operate it as shown in the sketch.

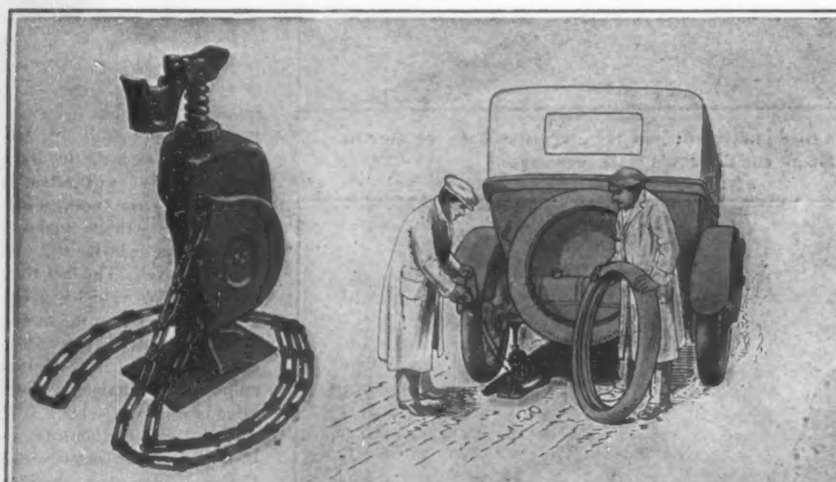


Pedal-operated dimmer for the headlights

The various headlight ordinances have offered an excellent field for the accessories manufacturer, and this season's offerings include a wide range of headlight lenses, reflectors and dimmers. One of the most striking of these in point of novelty is the butterfly light control, which consists of three nickel-plated steel wings which fit over the lamp socket in the manner shown. A control wire housed in a coil wire connects these wings to a pedal set in the floor of the car, thus giving the driver positive control of the headlights. Full glare on the road only may be obtained; the wings are opened or closed instantaneously. It is claimed that this device meets the requirements of the various headlight ordinances, without the use of special lenses.

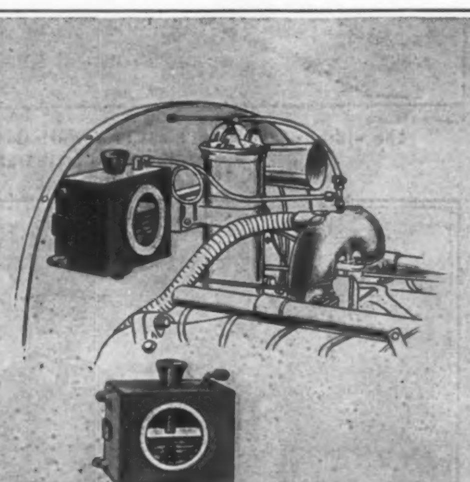
A warning bell

A double warning is given by this attractive bell which is mounted on the radiator cap of any car. The bell gives a clear, penetrating tone, while an 8-volt tungsten lamp flashes a red warning. With this device it becomes a simple matter for anyone to determine immediately which of the cars in a crowded traffic is doing the signaling.



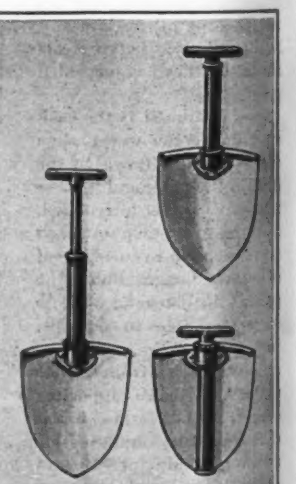
Pulling a continuous chain to jack up the car

As explained before, jack designers and manufacturers this year are intent on keeping the car driver at a safe distance from all mud, dirt and grease should the occasion arise for jacking up the car. Another typical offering along this line is a chain-operated jack which is shown in the accompanying illustrations. This jack is placed under any part of the car in the usual manner, after which it is operated by pulling on the continuous chain. The top is provided with a hinged guard piece which may be used if desired. By pulling on the chain one way, the jack is raised, and by pulling in the opposite direction it is lowered. The mechanism is geared in such a manner that very little effort is required to raise the heaviest passenger car, and as in the case of the long-handled jack already described, there is no danger of kick backs or blows. The sketch depicts the chain-operated jack in use for the changing of tires. It will be noted that the operator is not required to kneel or stoop to work the new jack, but merely pulls the continuous chain until the desired clearance is attained. The chain-operated jack is substantially made and will withstand hard service.



Solving the carbon problem at its source

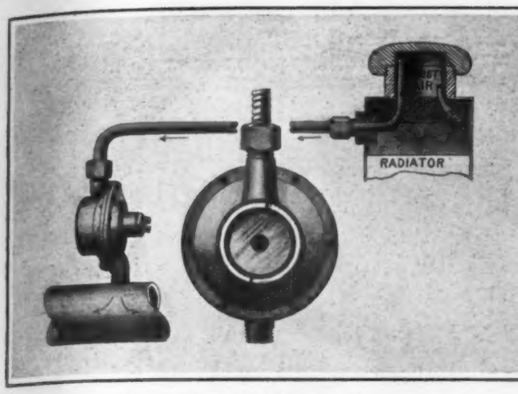
Carbon is the *bête noire* of motoring. Every driver knows how well his car runs just after having the carbon cleaned out. The car is then full of life; it jumps when the accelerator is touched; it climbs with a powerful, sweeping rush, yet it can be throttled down to a walk in high gear. In order to maintain this high efficiency there have been developed a number of carbon-combatting devices which are claimed to eliminate carbon permanently. The type shown herewith may be readily installed on any car. In official tests conducted by The Automobile Club of America this device has proved the following points in its favor: Decreased fuel consumption; increased speed; increased power; smoother operation; more nearly perfect combustion; and no carbon deposited.

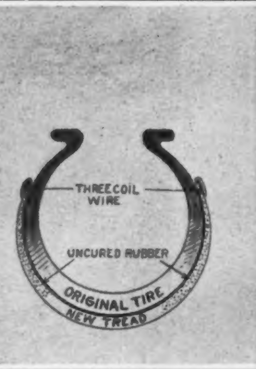


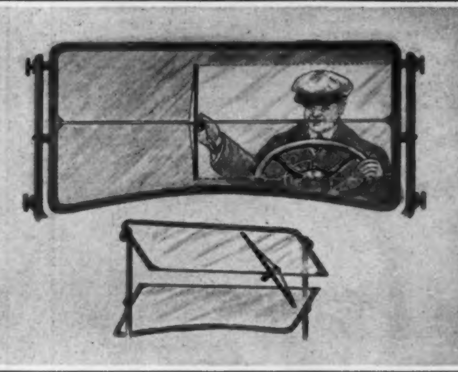
Telescoping shovel for the tourist

So long as the motorist keeps on paved roads, he has no use for a shovel—except in snow-bound weather; but the moment he undertakes an extended tour he soon finds the shovel a most useful tool. One of the offerings this season is an all-steel telescoping shovel which requires no more space than the size of its blade. It has a 16-inch handle, weighs two pounds, and is finished in nickel-plate. To use the shovel the sections are extended and securely locked in position.

NEW IDEAS IN AUTOMOBILE ACCESSORIES







Another device for doing away with carbon

Operating on the principle that the introduction of moist air into the cylinders of a gasoline motor with the gasoline charge increases the power, decreases the fuel consumption, and eliminates carbon with its attendant troubles, the simple device here shown commands attention. The illustration also depicts the method of installing the device so that moist air is taken from the radiator and introduced, with the mixture, through the intake manifold to the cylinders. A set-screw is provided at the rear of the device for adjusting it to any engine. This device provides an easy method of priming the motor when it is cold, or flushing the cylinders with water, by simply removing the filler cap and pouring the required amount into the tube. The installation is obviously somewhat involved, but it may be effected by anyone handy with tools.

Rebuilding worn tires

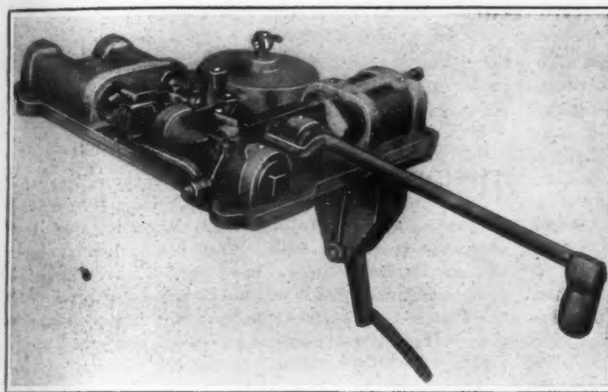
Getting the most out of a tire is quite consistent with the economy program of war time. One offering in this line is a simple shoe which may be used to build up a worn shoe in the manner shown. The new shoe has an inner coating of uncured rubber which becomes tacky when gasoline is poured on it. The tire may be used 20 minutes after it has been repaired. In warm weather the new shoe, by virtue of its uncured rubber, is practically self-vulcanizing.

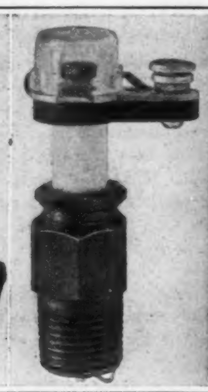
Keeping the windshield clear of rain and snow

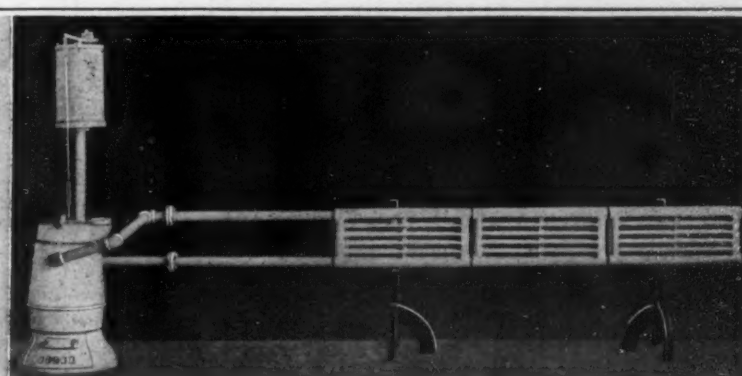
During heavy rain or snow a driver must either dispense with the protection of his windshield or assume the risk of driving in a half-blind state. At least, those are the conditions if he has not provided his car with a rain rubber. Last season's offerings included rubbers which wiped part of the glass in front of the driver, and either fastened at the top of the windshield frame or required the boring of a hole through the glass. This season's offerings include a simple rubber which operates along the slot formed by the two panes of the usual windshield, and wipes the windshield throughout its length and width. It will not rattle, nor will it scratch. Two pieces of flexible gum rubber are used on each of the cleaning arms, which not only clean but wipe dry at a single sweep.

Grease cartridges for grease cups

Clean hands is the order of the day in motoring; a driver does not have to dress in a pair of overalls or include a long protective coat among his traveling togs for the occasional repair while on the road. Driving is becoming—indeed, it has become—a Sunday-dress affair. In keeping with this phase of development is an oil cup which takes its grease in the form of neat cartridges, wrapped on all sides except the bottom in clean, waxed paper. The cartridge may be inserted by white-gloved hands if necessary, and a turn of the plunger handle sends the grease under considerable pressure to where it is required.







Replacing muscles with hydraulic pressure in gear shifting

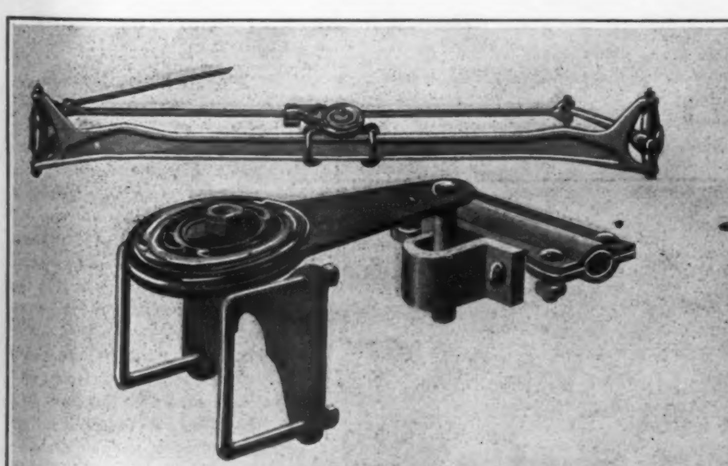
Within the past few years many systems of shifting gears by electrical or pneumatic means have been introduced and, indeed, form part of the standard equipment of some cars. Instead of the toilsome task of manipulating a gear-shift lever, the modern way is to press buttons or move a small indicator arm. Among the recent schemes for shifting gears is that of L. A. Laursen of Eau Claire, Wis., which is shown in the accompanying illustration. This device operates on the hydraulic principle, and represents some fifteen months' effort on the part of the inventor. The operation of the control lever requires no more exertion than does the movement of the spark and throttle levers. In fact, its motion and operation are very similar. Due to its location, its movement is not subject to interference by robes in winter driving, as is the case with the conventional shift lever, or by a change of position on the part of the driver. In this system the gears are shifted through the action of the clutch pedal. They are shifted to any desired position by merely setting an indicator lever and then pressing the clutch pedal to the extreme downward position. Oil pressure is depended upon for the operation of the mechanism.

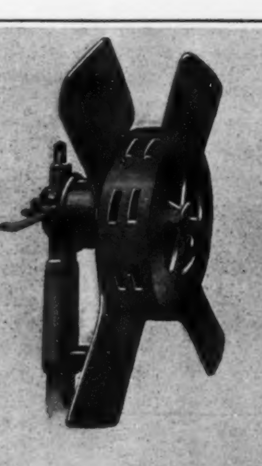
Novel spark plug

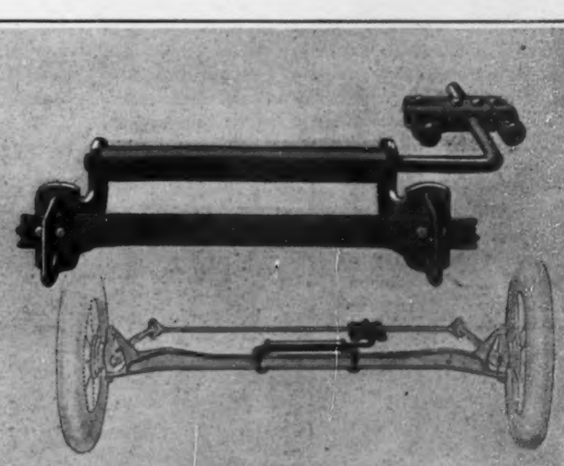
By using a newly-invented spark plug it is possible to raise the hood and, at a glance, view the workings of all the spark plugs of an engine. The device shown is the invention of a 22-year old jacky, Richard E. Hildebrand of Chicago, Ill. A circular trench acts as a spark gap which is surmounted by a protecting glass dome through which the spark in series with the spark plug proper, may be observed.

Heating the garage for the year-round motor car

The number of motorists who drive their cars in winter is increasing greatly each year because they prefer to have their automobile and garage investments pay them dividends every month of the year, instead of just in warm weather. And an automobile depreciates no more in serving than if it stands idle, a no-dividend-paying investment. But this requires a warm garage to insure a quick start and proper functioning. All of which leads up to the subject of heating the garage. Heating systems for garages have been rapidly developed, and today the motorist can obtain complete plants which are more than just a stove. The system illustrated above, for instance, is a coal-burning, self-regulating, hot-water system that is automatically regulated. The water in the pipes carries the heat from the heater to every part of the garage. The plant burns only five cents worth of coal a day because water when once heated requires very little fire to keep it at a certain temperature. In the morning the fire is attended to and for the balance of the day it takes care of itself. In unusually cold weather it requires further attention in the evening. Otherwise the desired temperature is maintained automatically by a regulator which controls the fire, preventing unnecessary fuel consumption. The plant is absolutely safe because the fire is surrounded by water in the water jacket that separates the fire from anything in the garage. The heater can never get red hot; and the fire underwriters have approved of its use for the purpose intended.







Keeping the light car on the road by mere friction

Statistics from accident insurance companies show that over 90 per cent of claims paid on automobiles are due to the car hitting some obstacle and turning to one side of the road—and in many cases turning completely over. Expensive cars equipped with the worm sector gear are immune from such dangers, but the light car of inexpensive construction has a tendency to turn if an obstruction is encountered. The accompanying illustration depicts a device which, when attached to the light car, makes it drive on rough roads as though it were equipped with a worm gear. The device consists simply of steel and fiber plates which furnish the friction. This friction stabilizes the steering and guides the car just as directed by the driver, relieving him of much of the strain. There are no springs of any description, and the mechanism can be mounted on the front axle and connected by the average handy man with the help of a monkey-wrench.

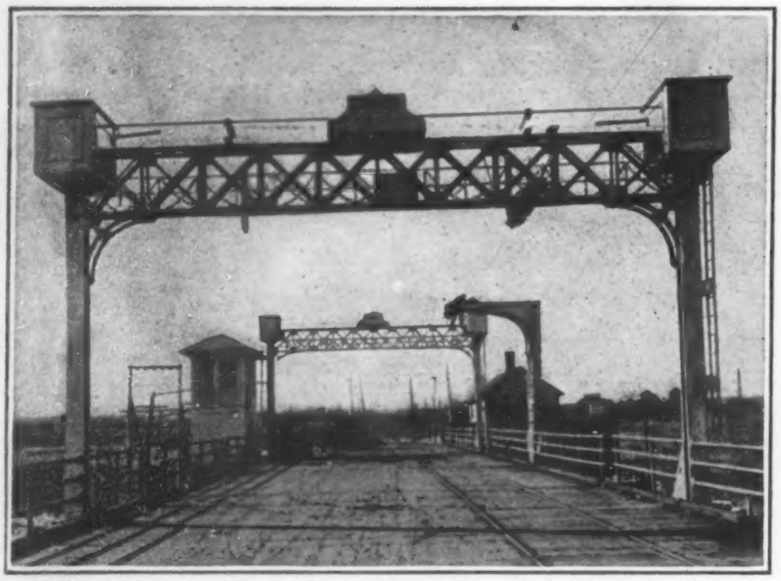
Combined engine fan and horn

The engine fan has already been used as a generator for the lights of the moderate-priced car, but this is probably the first time it has been arranged to do duty as a warning signal in addition to its regular task of drawing air through the radiator and keeping the engine cool. The fan shown is arranged so that when a cable control is operated, it emits a loud and piercing howl.

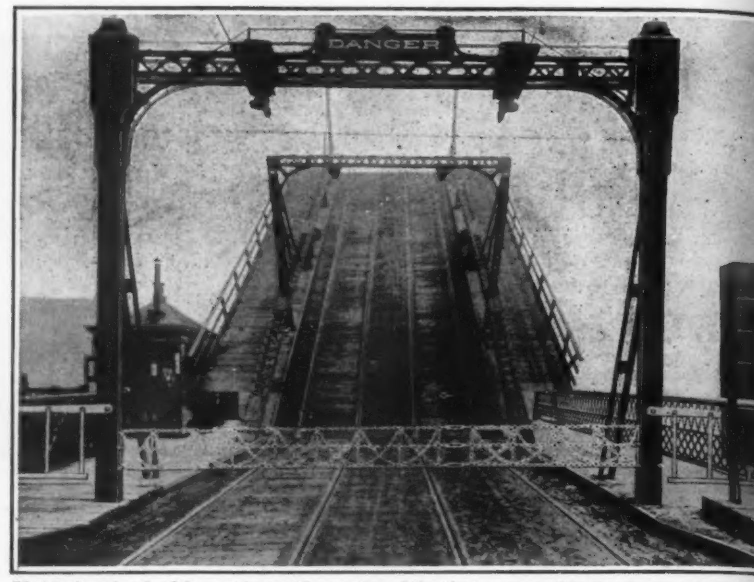
A compressed spring which helps the driver

Another offering designed to help the driver of the light car makes use of a compressed spring instead of the friction principle. This device consists mainly of a steel spring held in a steel tube and packed in grease. Dirt, mud, water, and other foreign substances cannot enter the tube and interfere with the operation of the spring. The spring, being compressed instead of extended, does not break. Another feature is that the connecting rod merely rests on the tie rod attachment and works on roller bearings, allowing the tie rod to vibrate freely without affecting the device. The tie rod attachment is placed well towards the end of the tie rod where there is the least vibration. The device is light in weight and 85 per cent of the weight rests on the axle—the strongest part of the car. Only a monkey-wrench is necessary to install it on the car in a few minutes' time.

NEW IDEAS IN AUTOMOBILE ACCESSORIES



The flexible crossing gate lifted to the position which it occupies when the coast is clear



If this barrier had been there, the automobile that ran up this bascule and over the edge would have been checked

A Yielding Barrier That is Fool-Proof

Halting the Speed Maniac at the Drawbridge and the Railroad Crossing

THE driver of motor cars who will not "Stop, look, listen," and who dashes madly across railroad tracks in spite of the watchman with a flag, or a flimsy barrier of wood, will now be deprived of the opportunity of taking a chance; for a scientifically correct form of barrier has been devised which will check him in his career and bring him to a stop, against his will if need be. It is not a rigid gate of wood or metal against which the machine can be wrecked, for the inventor realized that to drive a car against a heavy barrier that cannot yield, is almost as serious for the occupants as to strike the train. In either case the automobile would be smashed and the passengers injured or killed

Therefore a yielding barrier was devised which operates on the principle of a costly fishing rod, a slender length of bamboo or steel that bends under the struggles of a big fish, but never breaks. Such a barrier has been installed on a drawbridge in New Jersey with satisfactory results and the principle is therefore a demonstrated success which can be extended to railway crossings and bridges all over the country.

In its simplest form it consists of two metal posts set at each side of the roadway, between which extends a net of wire cables, somewhat after the manner of a tennis net. By a system of counterweights and brakes this net is paid out with increasing resistance when it is struck by a car, until within a distance of 15 feet the vehicle is brought to a stop. This device will take care of a heavy machine traveling at a high rate of speed, halting it before the railroad track is reached (or the open draw, in case it protects bridge traffic), yet operating so easily that the machine and the occupants are not endangered. That such positive protection is needed at grade crossings and drawbridges is a demonstrated fact. The efforts of a railway company on Long Island to reduce accidents at crossings led to a study of the habits of motorists, and the percentage of drivers who ignored the signals and wooden barriers was astonishingly large. Even the watchman with a flag could not prevent such criminal carelessness; in fact, one watchman was struck by a car that he was trying to keep out of danger from an approaching train. The same recklessness is found at the approach to open bridges, and a case will be recalled of a car in Chicago that actually ran up the incline of a partly raised bascule bridge and plunged into the river from the top, resulting in the death of all the passengers.

Several types of yielding barrier have been planned during the eight years in which it was being perfected, but all of them have the same general principle, and the variations simply allow for different widths of street and the presence or absence of trolley cars on the thoroughfare. Thus the metal posts may be of varying height to suit local conditions. Two may be used alone, or two with a cross strut, or on a wide street it may be desirable to use three posts.

But in all cases the design is essentially the same: the barrier is composed of three longitudinal cables connected by independent cables that cross it to form a network with a large mesh. This is suspended high above the traffic when the road is clear, and provision is made for non-interference with trolley wires. On the approach of a train, or before opening a bridge, the barrier is lowered, and this may be done by a variety of means. In case of a drawbridge the mechanism may be operated from the bridge operator's house, and is designed to interlock with the mechanism of the device for opening and closing the bridge. This affords positive and automatic protection, as the bridge cannot be opened without lowering the barrier.

However, in cases where three supports are used to a roadway over a bridge, the barrier at each end may be divided into two sections, one for each side of the road. This makes it possible to leave one side open at each end in order to permit vehicles to pass from the bridge, while the other side is closed against traffic entering the bridge.

With the yielding barrier in position, the usual warning signals are provided, such as "Stop" signs, bells, or flag men. By night a particularly effective illumination is provided for in the shape of a series of red lights that cast a glow over the entire network of the barrier, so that it cannot be overlooked by the most careless driver.

In case the vehicle does not come to a halt it cannot pass the stout but resilient cables. Lowering the barrier to place automatically sets the brake and a car striking the barrier causes it to pay out against the gradually increasing resistance of this brake until the machine is stopped. Then as the car is backed away from the obstacle, the counterweights operate to bring the cable back into position.

The counterweights and brake are set within the side posts and very little underground work is required to instal the device. It has the additional advantage of presenting a neater appearance than the old style swing-ing gates of timber or iron.

A fatal accident prevented by a flexible barrier that gives and stops the reckless driver so gradually that he cannot break through

Airplane Oil from the Philippines

BESIDES showing their patriotism by raising and equipping 25,000 troops for service overseas, the Filipinos may come to our rescue in getting our great aeroplane fleets into the air and into action. Federal officials in this country have cabled the Philippine government asking if it will not be possible to produce in the islands an adequate supply of lubricating oil for airplanes from the tangan-tangan weed, or vine, which grows wild in abundance throughout the archipelago, and which produces an extremely good oil suitable not only for the lubrication of delicate machinery but which is also used by the natives medicinally. The plant creeps, and has blossoms like the flower of the honey-suckle.

As a result of the inquiry made by our own officials the business men of Manila, American and native, are investigating the plant with a view to exploiting it at once, and whether or not extracting the oil in commercial quantities for use during the war is successful it is nevertheless a possibility that the interest now developed will ultimately lead to the forming of a new industry in the islands which will have a marked affect on the oil markets of the world. It is thought that at least 1,000,000 gallons of oil per year can be obtained from the wild weed supply, and that this can be greatly increased by cultivation.

Standard Workmen's Houses in the United Kingdom

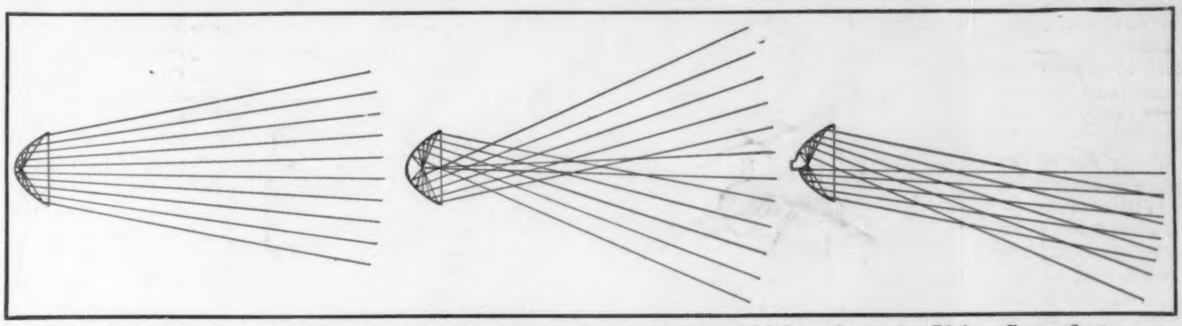
THE urgent necessity for providing suitable housing accommodations for the working classes, owing to the great scarcity which has arisen from war conditions, is engaging the serious attention of the British government. Definite action is now reported, and it is intended that the Local Government Board shall control the operations of the national housing scheme. Particulars have been requested from the various municipal councils in the country for the requirements of their respective areas, and it is stated that 100,000 new dwellings are required. The government proposes, however, to erect from 150,000 to 200,000 dwellings to meet the demand which may exist after the war, and also to grant a subsidy of several million pounds sterling for this object.

The prospective plans are to construct standardized houses with a slight variation in dimensions and style for different localities. Where conditions permit, the cultivation of gardens will be encouraged to increase the food production of the country.

Lights That Shine Where They Are Wanted

Some of the Devices Which Have Been Put Out to Secure Proper Headlight Control

FOR many years the only use for a headlight was on a locomotive. Road traffic was conducted wholly by means of horses, and after dark there were few drivers with the temerity to indulge in any but the most moderate pace. The only illumination necessary was then a lantern hung at the shaft's end to make it clear to drivers of approaching vehicles that some one else was on the road.

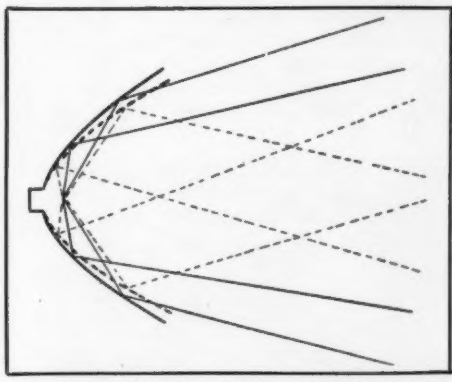


Left, divergent beam with lamp in rear position; center, convergent beam with lamp forward. Right, offset reflector that combines the two and sends all light downward

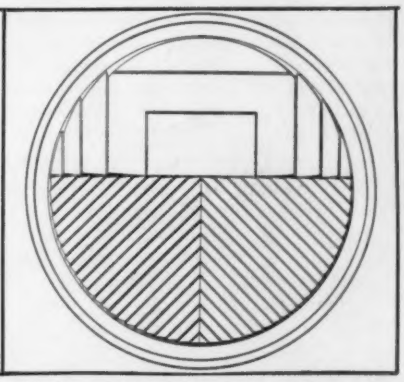
With the coming of the automobile, however, it was no longer the case that any old kind of a flicker was sufficient for a headlight. When we begin to dash about the country in the dark in a vehicle that makes twenty or thirty miles an hour and does not run on tracks, we must have a headlight that really throws a beam of light worth while, so that we may see whither we are headed in time to avoid the danger spots. And with this the headlight problem comes in; for at once we have the conflicting demands of the driver for illumination of the path stretching out before him, and of the rest of the community for deliverance from a gigantic dazzling sun rushing upon it from out the darkness. In a word, we must have light without glare; the driver must see his road, and the people in front of him on that road must likewise be accorded the privilege of vision.

The devices put out to accomplish this happy reconciliation are legion in number—and so are the legal enactments designed to force the automobilist to conform with the particular crotchets of the particular legislative body concerned. All this has led to great confusion; it has seemed that no two cars in the world were similarly equipped as to headlights, while the unfortunate motorist engaged in interstate touring has had to halt and dismantle the whole front of his car every time he approached a state line. Of late, however, a certain degree of order has been brought out of this legal and mechanical chaos by emphasis placed upon the elevation at which the light throws its beam, rather than upon the brightness with which it shines. It has dawned upon us that it is possible to satisfy all the requirements of safety by projecting our light upon the *surface* of the road and keeping it out of approaching eyes, and that such a light may with safety be made as bright as we please.

Accordingly the New York law, one of the first in the field and one which promises to become a model for state legislation, makes no effort to define the maximum brightness with which it is permissible for a headlight to shine; it defines merely the zones in which it may and may not throw its beams. It is obvious enough that if no light strikes the field higher than 42 inches above the ground, no light can shine in any eye and nobody can be dazzled. It is even permissible for light to be thrown higher than this, *on the motorist's right;* for any person facing a car from that quarter is on the wrong side of the road, and outside the pale of protection. Realizing all this, and taking their cue from the New York law, makers of accessories have been busy devising some means to confine the headlight beam to the safe region.

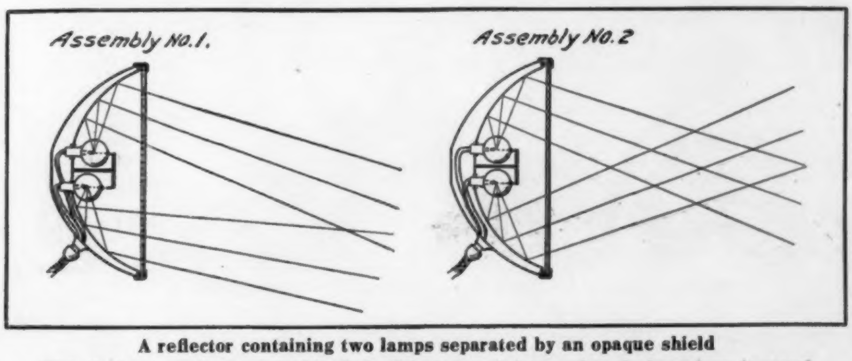


The hinged reflector showing how distribution of light may be controlled



This lens sends a beam down the road's center and a fan that reaches the edges

The simplest way of all, of course, is the old home remedy of painting dark that portion of the reflector which sends light to the proscribed region, or that part of the lamp through which this light reaches the reflector. In our issue of September 8th a gentleman who ought to have known better advised all motorists to adopt this easy scheme, because there were no patent rights involved. This is not quite accurate; U. S. patents 1,144,676 and 1,154,824, issued to R. F. Wilson, cover in unmistakable language the painting of both reflector and light-bulb *in an automobile headlight* to control the focussing of the rays of light. While it might seem that Mr. Wilson must have been forestalled in such an obvious procedure, his claims are very clear and one of them has been upheld by the Board of Examiners in an interference case; so motorists may well be cautious of how they infringe them.



A reflector containing two lamps separated by an opaque shield

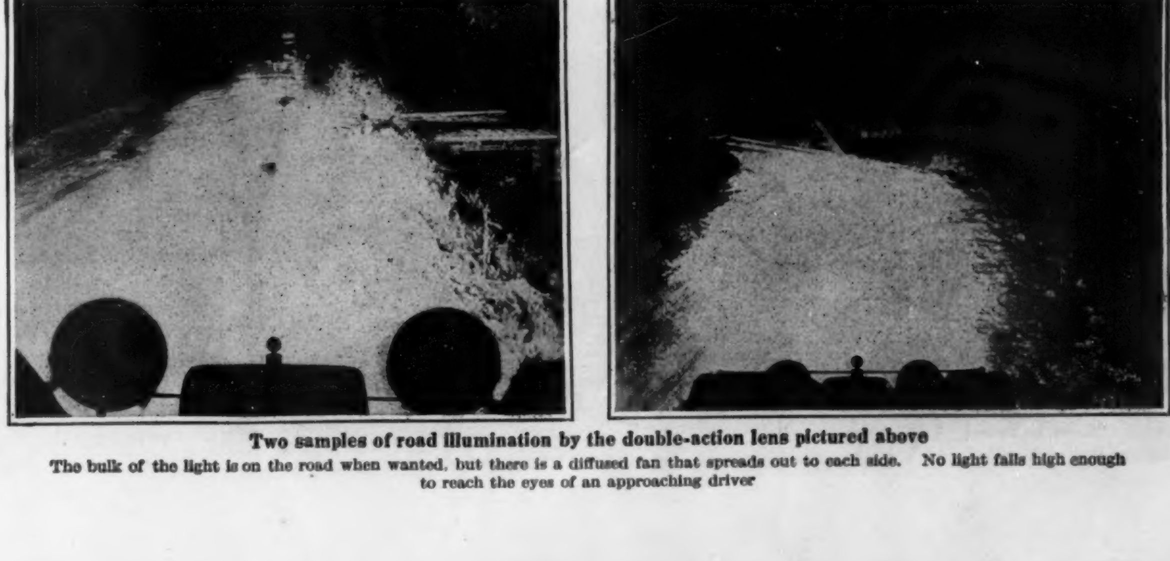
With the lamps as shown at the left all the light is turned down; when the lower lamp is moved out it sends its rays upward, as shown at the right

As a matter of fact there is really no necessity for the car owner to tinker with his headlight; there are now procurable a number of very good manufactured articles that cover the ground. Perhaps the neatest of these is the offset reflector. By moving the lamp nearer to or further from the vertex of a parabolic reflector, either of two types of focussing may be secured—a convergent reflection through a focus in front of the reflector, or a divergent reflection from a focus behind it. Our cuts show the two alternatives, which we repeat depend merely upon the distance of the bulb from the reflecting surface. The offset reflector is a combination of the two—the light is reflected convergently from the upper half, divergently from the lower half; and this is accomplished, as our figure shows, and as the name indicates, by a simple discrepancy in the positions of these two halves. Accordingly the light from both halves is reflected downward, where it is wanted, instead of half up and half down, as is the case with any type of pure parabolic reflector.

Another inventor has achieved the same result by hinging the two halves of his reflector at the vertex. Whenever the beam of light does not behave as he would at the moment have it behave, he is then in a position to adjust the matter by turning one or both halves of his reflector upward or downward. He has the obvious advantage over the offset reflector that his outfit is not rigid; when he wants the light high he can have it high, and when he wants it spread out high and low at the same time he can have it that way too. So the offset man has met this competition by a headlight with two lamps, arranged vertically, with an opaque shield separating them. Light from the upper bulb is then reflected only from the upper reflector, and light from the lower bulb from the lower reflector.

The upper bulb is fixed at the "forward focal point," from which light is reflected convergently, and hence, in this case, downward. The lower bulb, on the other hand, is adjustable; ordinarily in the "rear focal position" from which its light is reflected divergently downward, it may be moved forward so that the reflector shoots its rays convergently upward. Accordingly, when in its normal state, this headlight may run with either or both lamps lit, and all the light given forth will fall upon the road; but when an emergency requires that light be projected upward, the lower bulb may be moved out, and used, either alone to light the tree-tops while the roadway remains dark, or in combination with the other bulb to light the whole field before the car. A complete set of controls governing the lighting and extinguishing of both lamps and the moving out and back of the lower one is of course furnished.

It might seem that this exhausts the possibilities in the realm of headlight control; but when we consider that we have not yet touched upon the intricacies of lens manipulation, it will be plain enough that it does nothing of the sort. From (*Continued on page 47*)



Two samples of road illumination by the double-action lens pictured above

The bulk of the light is on the road when wanted, but there is a diffused fan that spreads out to each side. No light falls high enough to reach the eyes of an approaching driver

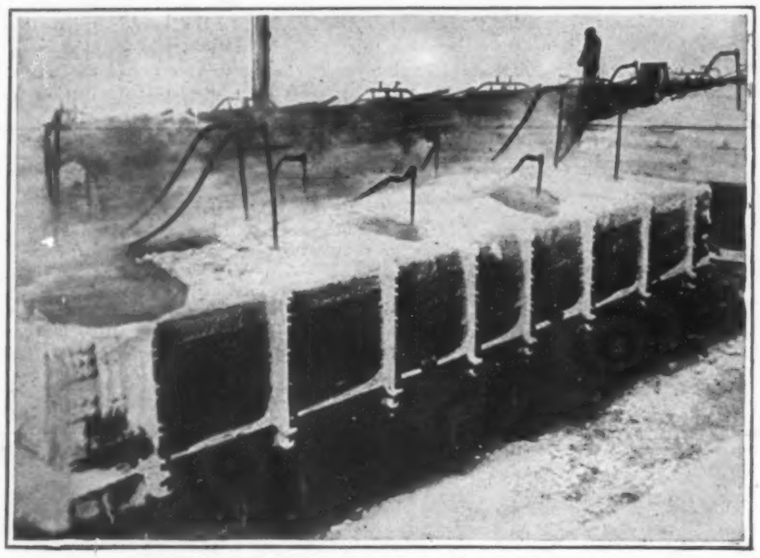
Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Remining Frozen Coal with Jets of Live Steam

HEAVY snowfall and the formation of dense masses of ice have made no end of trouble in the transportation and handling of coal in the East during the past month or two. Indeed, conditions have been so severe that in many cities there has been an acute coal famine, which, in large measure, may be laid directly to weather conditions.

Slow transportation is only one of the causes of the coal shortage in the centers of population, according to the accompanying illustration. Coal is often frozen solid in coal cars and has to be practically remined at the point of reshipment or unloading. Before it can be handled it has to be thawed out, and for this purpose there has been introduced a simple yet effective system of forcing live steam into the masses of frozen coal. This system, which is shown in the accompanying illustration, consists of a number of flexible hose ending in long nozzles which can be inserted in coal piles to be treated with the live steam.



Thawing out a frozen coal car with jets of live steam

Spraying Logs for Safety

AS a safety measure, logs at a northwestern mill are given a vigorous spraying under several jets of water, before going to the saw. The reason for this process is that bits of rock or gravel may become attached to the bark of the log while it is being transported to the mill, and if the swiftly revolving saw strikes one of these obstructions, trouble is likely to follow. The abrupt checking of a circular saw may cause it to fly in a score of pieces that are hurled in every direction like shrapnel. Therefore it is a wise precaution to remove any fragments of stone from the log, and the spray was found to be an effective method. The water is shot upon the surface with great force as the log travels through a chute, carried by steel rollers.

Removing adhering sand and stones from a log with sharp jets of water

Storing Gasoline in Closed Tanks

DURING the last eighteen months or two years much serious consideration has been given the threatened petroleum famine confronting the world today. Even to those who have not previously realized the importance of this fuel, it must be patent that a shortage, either of crude petroleum or more especially of gasoline, will militate very seriously against a successful prosecution of the war. Petroleum derivatives drive our latest dreadnoughts, our submarines and our airplanes, as well as our fleets of munition and supply trucks and the British and French tanks which so recently carried terror into the "Hohenzollern" trenches of Flanders.

The Government has recognized the seriousness of the situation, has considered legislation for control, and has appointed committees for investigation. The Federal Trade Commission has control of prices under consideration, and the Advisory Commission of the Council of National Defense has appointed a Sub-Committee on Petroleum. A review of the figures on production and consumption of crude oil will show that some solution must be found or a shortage will have to be faced. This country is producing crude oil at the rate of about 300,000,000 barrels a year, but it is using 325,000,000 barrels every 12 months. The amount of crude oil in storage, all grades, May 1st, 1917, was 165,688,797 barrels. The country is absorbing the entire current production and drawing very rapidly upon its reserve supplies.

Much has been done to increase the yield of gasoline from crude oil. The first increase was had by lowering the gravity of gasoline by distilling off more of the heavy oils, or kerosene. This has not been a solution as it has resulted in a much less satisfactory fuel for motor cars and similar uses, and cannot be continued any further. The Burton and Rittman processes, of which much has been written, have assisted, as have also better methods of refining, with the elimination of many former losses at the refineries. Another gain has resulted through the collection of so-called "casing-head-gas." This gas escapes from the well, due principally to the release of pressure as the oil rises toward the surface. Formerly it was a loss except in some localities where it was used for power to pump the wells. Such gas is now enclosed at the top of the well casing, and drawn off through vacuum pumps, where it is made to yield a very high grade gasoline which, when mixed with lower grade fuel, enriches the whole.

All these solutions, valuable as they have been, are inadequate to meet the situation. There is, however, one great source of loss, which, while fully recognized, has not been eliminated. Large quantities of crude oil are lost in storage tanks before ever reaching the stills of the refinery. The oil is first delivered to receiving tanks at the well where it is permitted to settle for a time before being gaged. This process separates out the the bottom settlings, which are run off. Incidentally, while this settling is taking place a large quantity of the lighter crude evaporates. This evaporation for an average crude can be estimated very conservatively at one per cent, although in some cases it may amount to five per cent or more.

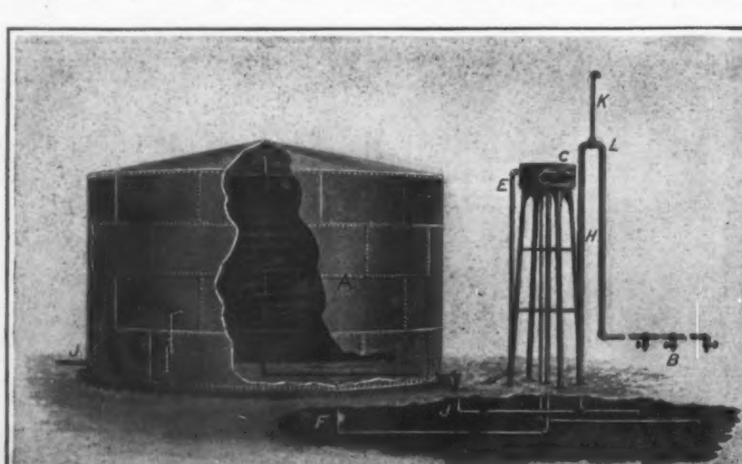
The oil is next delivered to storage tanks. Formerly open, these are now roofed over, but must be vented to permit the exit of gas which would otherwise burst the tank. Another large evaporation loss occurs in these tanks, which is even greater than in the receiving tank. In fact, it is not uncommon, when the atmosphere is right, to see a tank farm enveloped in a cloud of vapor, all coming from the vents in the tanks—of course, greatly increasing the fire risk. Some attempt is now being made to reclaim this vapor by means of a vacuum system, but it has proven very expensive and not a great success.

These and other items of evaporation loss prior to and during refining have been very conservatively computed as approximately 4.9 per cent of the marketed production as gaged to the storage tanks. For the estimated production for 1917, 300,000,000 barrels, this loss is 14,700,000 barrels. It must be remembered that this evaporation is not of commercial gasoline, but the very best fraction of the crude oil which is worth much more to the refiner than commercial gasoline. Even at 20 cents a gallon, the average retail price today for commercial gasoline, or $8.40, per barrel, the loss of 14,700,000 barrels of high grade fuel amounts to $123,480,000 annually.

We believe this estimate of loss to be well within the facts. Professor Bryant, in his book "Petroleum" refers to a Pennsylvania crude which his tests showed to lose, in an open tank, 25 per cent in a single week and 35 per cent in five weeks. This is unusual and is not applicable to our average 15 per cent gasoline crude, although it shows the extreme loss in some crude oils. A better case in point is that of a mid-continent company which in 1915 produced or purchased, and refined, 18,000 barrels of crude oil daily. For this year, the most careful measurement and computation indicated that the net evaporation loss on this total was seven per cent. The company in question undoubtedly handles the fluid as economically and with as small loss as any refiner in the business. Owing to the relative location of fields and refineries, terms of selling contracts, and other conditions, they did not store crude oil for any great length of time, which again tends to show that these estimates are all very low.

Of the various proposals to conserve the enormous losses existing today, the Farr system of storage holds the greatest promise. The basic feature of the system is that, if expansion of vapors above the crude oil in the tank can be cared for without a vent, there will be no bursting of tanks. Then, without the constant breathing of air in and out of the tank through the vent as a result of change in temperature, there will be no evaporation and consequently no loss or fire risk.

The system as applied to storage tank and refinery is shown diagrammatically on this page. Its operation is based upon the facts that water and crude oil, or any fraction of the latter, will not mix, and that a column of water will balance a greater column of crude oil, or any of its fractions. The difference in weight which brings about this state of affairs will vary somewhat. Systems accordingly have to be slightly modified to suit the material to be stored. A fair average figure, however, is that one foot of water will balance 16 inches of gasoline, or in a ratio of 3 to 4.



A schematic representation of the Farr storage system for gasoline

In our figure A is the storage tank, which is not vented. C is an automatic level

water tank. E is an overflow pipe to drain. H is a supply pipe for conveying oil from tank A to refinery, with outlets B.

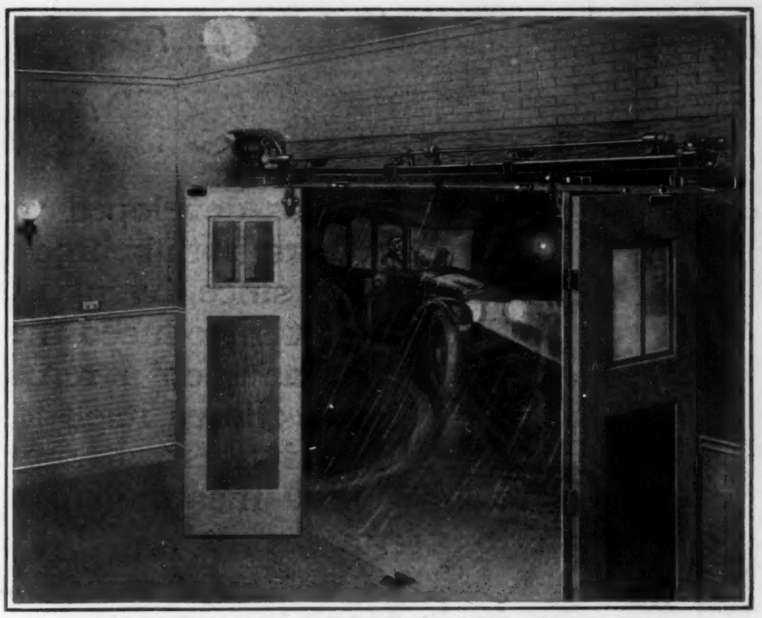
Tank A is originally filled with water. Crude oil is then supplied through pipes J. This displaces the water from tank A forcing it through pipe F to tank C, where it overflows through pipe E to the drain. When oil is desired at the refinery, by opening any of the outlets B the water head from float box C will cause the oil to flow through pipe H. Pipe H rises to a point above the top of tank A, where it is equipped with siphon breaker K; this to prevent the siphoning of the fluid from the storage tank. As evaporation and condensation follow one another in the tank the variation in bulk is taken care of automatically by variation in the water level, without any loss of petroleum or petroleum vapor.

Pipe J is the connection to pipe line or railroad car for refilling tank. If it is more convenient, filling can take place from the refinery end of the system through pipe H, but it would not be possible to fill through pipe F, since it is through this pipe that the water escapes from the tank. There is no possibility of water flowing through pipe H to the refinery inasmuch as water could not force itself above tank C. It can, however, support the column of oil extending above its own level to L; and as remarked above, it is this that makes the system possible. It is to be noted that the storage tank will never be entirely emptied of oil but may be so within a small percentage. The height of the loop L will determine the amount of oil left in the tank. No attempt has been made to show a working system; it must be apparent to the reader that such a system would involve a great multiplication of tanks, pipe lines and points of delivery, which would complicate the diagram to such a degree that it would be difficult to follow a description of the basic principles.

The system involves the pumping of water instead of oil, thereby reducing operating costs and fire hazards. Moreover, any overflow that may occur will be of water. Not many years ago one of the largest automobile manufacturers lost many thousand gallons of gasoline as the result of a miniature flood which submerged the filler pipe to his underground storage tanks. As the water flowed into the tanks the gasoline was replaced, until the entire factory was flooded with gasoline. Fortunately it did not become ignited, but the fear felt by the management and the difficulty of clearing it all away can be appreciated. Another similar case, only much more disastrous, was the result of overflowing of tanks with water that was being thrown on a fire by the fire department. It was a bad fire, but undoubtedly would have been conquered at a moderate loss had not the added conflagration due to the gasoline made conditions hopeless.

Such disasters cannot result in the Farr system installation, as any quantity of water can run through the tanks, merely passing through to the drain. Another great advantage of the system is the impossibility of getting dirt or water with the gasoline or oil, because these fluids are delivered from the top of the tank. In pumping from an underground tank the suction pipe must lead to the lowest level to which it is desired to empty the tank. Such a tank will keep clean, but only as a result of pumping out the dirt and water along with the gasoline. This dirt and water in gasoline is not only a great annoyance but also is a source of much danger as it is customary to throw these impurities—with such gasoline as they may carry—upon the floors or into the sewer.

So the Farr system not only conserves gasoline, but on grounds of convenience and safety also is superior. Accordingly a number of the large refiners are giving serious consideration to the adoption of this system on a large scale and it is perhaps not out of the way to anticipate the day when it will represent standard practice.



A garage door that can be opened without leaving the car

Opening the Garage Doors by Push Button

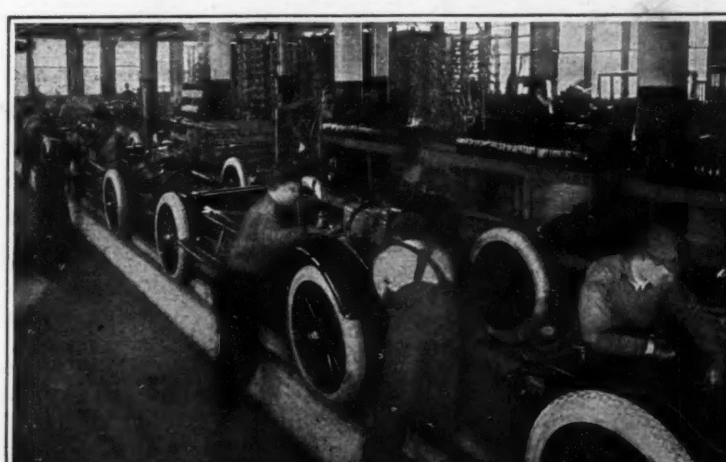
WHETHER it rains or shines it is a convenience to be able to open the garage door and run the car in without stopping to alight and unlock it. By an electrical device recently patented the garage door can be opened by pressing a button which turns on the lights in the building, unlocks the door and folds them back clear of the opening, all within a few seconds' time.

The push buttons are arranged on a metal post outside in a convenient place at the side of the driveway where the driver can reach out with one hand and operate the device. One push button opens up the garage, another closes it while a third stops the doors instantly. Provision has been made through a spring checking device to prevent accidents to persons or machines, should they, by oversight, be standing in the opening after the closing button has been pressed.

In cases of emergency, as power being off, etc., a slight pull of a lever disengages gears, and the doors can be hand operated. The doors are mechanically connected so that the opening of one section also opens the other.

When the push button device is outside they may be operated with a cylinder lock, so that no one besides the owners can enter the garage.

The device is very simple to install and can be placed wherever there is 12 inches space above the doorway. The maintenance after installation is practically nothing.



Cars right side up on the second story, after leaving the Ferris wheel

What the British Think of Coal Gas as a Motor-Car Fuel

THE question of driving motor vehicles with coal gas as a substitute for gasoline continues to attract attention throughout the United Kingdom. The press is devoting much space to the discussion of its advantages and disadvantages. The concensus of opinion appears to be that it is a practical proposition, and should be adopted as widely as possible, at least for the present in order to conserve the gasoline supply. The British Commercial Gas Association has been carefully investigating the subject, and in its report declares that coal gas in the present emergency may be advantageously used as a substitute by providing a large flexible holder in which the gas is stored approximately under atmospheric pressure.

There are no difficulties in adapting the ordinary engine to run with this fuel, as it may be employed without any structural alterations. Another important point is that no alteration in the carburetor is required. The gas bag is merely placed on the top of the car or van, and has one outlet and one inlet. The gas is carried to the carburetor and thence to the engine. The latter may be switched immediately from gasoline to gas or vice versa.

The experiments of the British Commercial Gas Association led to the conclusion that the equivalent of one gallon of gasoline is about 300 cubic feet of gas, but other experiments have given only 250 cubic feet or less, depending on the quality of the gas. Coal gas worth 16 cents would do the work of a gallon of gasoline.

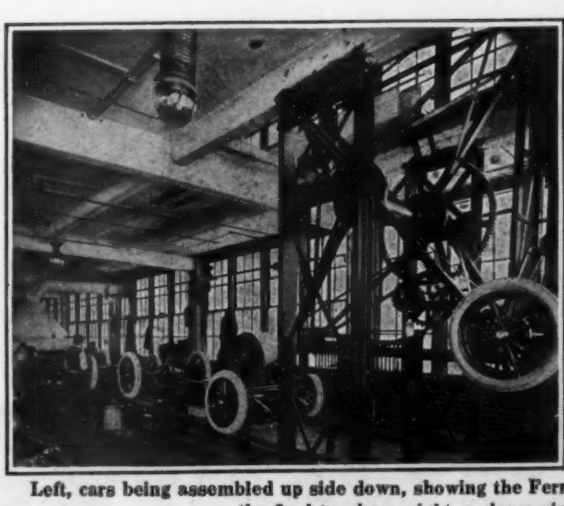
A Ferris Wheel for Assembling Automobiles

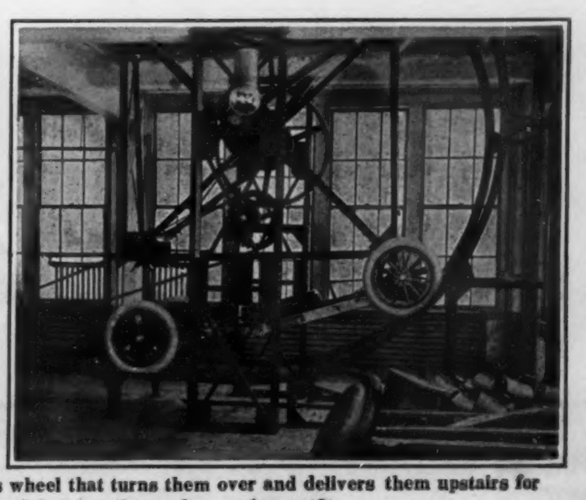
OPERATING like a Ferris Wheel, a conveyor for handling automobiles which are in process of assembling turns over the cars at a certain stage of the work, elevates them to an upper story and sends them along that floor in a position which is the reverse of that at the start.

The object of this device is to allow the mechanics to do the work on the under side of the machine without the necessity of getting under it, and thus it is possible to work with greater ease, and more can be accomplished with less time and labor.

This unique conveyor is in use in a large automobile plant in Detroit and the details of its operation are about as follows: on the first floor the bare frame of the car is placed upside down on the conveyor and travels the length of that floor in this position. The operations at that stage include the placing on the machine of running board supports, mud pan and braces, springs and axles. Entering the spraying chamber the chassis receives a coat of paint and thence goes to the oven for baking. Then just before reaching the big wheel at the other end of the first floor, the wheels with the tires are attached.

At this point an electric motor driven wheel takes hold of the chassis and carries it around an arc that elevates it through a hole in the floor above, and places it on a conveyor there, right side up. On the upper floor those parts are attached that can be handled conveniently from the top side. The engine is set into place by an overhead crane; then come fenders, running board, steering wheel, etc., and finally, by means of an overhead monorail system the body is added.





Left, cars being assembled up side down, showing the Ferris wheel that turns them over and delivers them upstairs for the final touches; right, a closer view of the elevating and reversing outfit

The Motor Car of the Future

(Concluded from page 5)

it? What's that great brute of an engine idling under the hood for?

Now, jump three jumps more. If the engine starts and lights and pumps and stops itself, why, shouldn't it *steer* the car? Revolutionary? Nonsense! That's what they said of "foredoors." Know what a foredoor is? Probably not, unless you have driven several years. All cars of today have them. That's what they said of electric starters—revolutionary, impossible, absurd—etc. Well, can you sell a thousand-dollar car—or a five-hundred dollar car, for the matter o' that—without a starter? You cannot.

And in the future the car with the steering wheel will be as obsolete as the car with the hand pump for gas or oil is today!

The car of the future will have no such thing as a "driver's seat." *All* the seats in the car save the rear one, will be moveable. Driving will be done from a small control board, which can be held in the lap. It will be connected to the mechanism by a flexible electric cable. A small *finger* lever, not a wheel, will guide the car. Another will attend to speed changes, buttons will light and warm the car, blow the horn, apply the brakes—everything. The driver will sit right or left as he pleases or even, on country roads, on the rear seat. Driving will be, then, what it ought to be, a mental, not a physical, exercise.

This is no wild guess, but the inevitable end of practice forshadowed in present developments. We have with us now for instance, the push button electric gear shift. It displaces the manual work of moving around a set of gears, and does the labor electrically, with energy stored in the storage battery by the engine. Of course, the car of the future will be without gears, but that is not the question—today we have gears but are simplifying our driving.

And don't protest that an electric cable can't carry all the controlling influences from driver to car, to engine, to lights, horn, brake, speed control, steering. The modern church organ has five banks of keys and hundreds of stops. Every key has an electrical circuit, every stop, every coupler, every pedal has at least one and sometimes several, and they all—the whole several hundred of them—go in *one* flexible cable so that a modern console can be moved about in the church, exactly as the modern control board of the future will be moved about in the automobile.

Pedals, levers, dials, contraptions of all sorts, will disappear. The interior of the car of the future will look like a little pleasure house, not the engine room of the U-boat. The engine—I won't quarrel with you as to whether it is electric, gas or steam, or located under the hood or the rear seat—will deliver and store enough power to do *everything* about the car that manual labor now does. The air-brake displaced hand braking on the railroad train, making greater speeds and safety possible—it has started, with its rival, the electric brake, to do the same for the motor. It will succeed.

Steam or electric steering has displaced hand steering on all great ships—why should *you* sit humped over a much-in-the-way-of-your-comfort steering-wheel, when your engine can supply the muscle and all you need to supply is the *brain!*

The motor car of the future will be low. You won't *climb* into it—you will *step* into it. Six-inch clearances will be ample, because the future won't have any bad roads. In any modern city any car could get along with a six-inch clearance. Fifty years ago and all cities had their muddy avenues, their stony streets, their impassable ways. Fifty years hence a mud road, a rocky road, a "bad" road will be as much a curiosity in the country as the Broadway or Michigan Avenue of fifty or a hundred years ago would be today.

Exterior excrescences are doomed. Present practice runs fenders into bodies, and has cleared the running boards of the boxes, battery cases, spare tires, acetylene generators, etc., of a few years ago. Future practice will—and very soon—banish all such "out-at-elbows" things as projecting headlights, knobby tire carriers on the rear, gasoline tanks that collect dust, license brackets with the license hanging loose and all such! At least *one* car has made a tremendous step forward in concealing the gas tank, and providing a circular tire carrier under the rear seat where it is hardly to be seen. The same concern has put out a touring model with a top which disappears into the body—no top-boot to adjust—and they have just started! Wait until they *all* wake up!

Just think of the idiocy of our present method of carrying license tags. Every State in the Union demands them. They are of nearly uniform size. And so—because they always did do it—every manufacturer hangs a bracket on the rear or sets it up, like a little card, on a rear fender. Why no one has thought of providing a couple of holes to screw the blame thing against the rear of the body where it can't rattle and can collect dust only on one side, further deponent sayeth not!

The car of the future will carry neither extra tires nor extra wheels. In the first place, if the non-puncturable tire desn't arrive—which it will, probably—and if the substitute for rubber is never made—which it will be—why, some one will come across with a substitute for air. What? Of course you mustn't ask me what it will be! If I knew, I wouldn't be writing this story. I'd be cutting coupons and refusing to speak to any one except John D. and Laird Andy. But the troubleless tire is on the way and the car of the future will have it. A spare tire in the future will be as extinct as the Dodo and as unknown as a spare engine, a spare gasoline can or an extra top is today.

The dew-dabs designed to make a car ride easily will go, too, because all cars will ride easily on good roads. Spring suspension will be easier, lighter, less complicated, non-squeaking, more effective, because less will be demanded of it. Ever hear of a railroad train that had to have snubbers or shock absorbers?

Well! I could run on for some time, but the Editor has a chopper for stories that run too long. So here it is in a nutshell.

The car of the future—all glass inclosed, power plant at point of power application, driven from anywhere by a small control board, no clutch, gears, transmission, gear shift lever (that's not a prophecy, there is a magnetic-drive now that eliminates those four nuisances)—will sit low, have a small clearance, ride easily over perfect roads, carry nospare tires because possessing punctureless or airless tires, have no exterior or interior excrescences and cost—like those of today, just whatever your pocket book can afford to pay—and a little bit more!

The Chemical Progress of America in Tabloid Form

At a glance the chemical progress of the United States since the war began can be learned from the following facts:

The country now manufactures practically everything along chemical lines.

The increase in capital invested in chemical industries was, in 1915, $65,565,000; in 1916, $99,244,000; and up to September, 1917, $65,861,000 over 1916.

Before the war 90 per cent of the artificial colors and dyes were imported, five or six concerns with 400 operatives producing 3,300 short tons per year. Now there are over 90 enterprises, each making crudes and intermediates.

Sulphuric acid, the chemical barometer, has doubled in production.

By-product coking doubled its capacity in the last three years.

Gasoline production has increased from 35,000,000 to 70,000,000 barrels per annum since 1914.

The production of explosives and consequent consumption of nitric acid has increased enormously. The nitric acid is still almost entirely made from Chile saltpeter, but synthetic nitrogen plants are under process of construction.

Before the war 40,000 tons of barite were imported from Germany for the manufacture of lithopone. Now five companies are producing this article in Tennessee, Kentucky, Virginia, and Missouri.

Lift the Freight Embargo

Use Troy Trailers in "Motor Truck Trains"

And get the results obtained by other big users who are covering regular hauling routes, ranging from 25 miles to 100 miles, with motor trucks and Troy Trailers.

Riker-Hegeman—one of the best-known drug companies—maintain a weekly delivery service between Philadelphia, New York and Boston. They say: "One Troy Trailer saves us $100 a week. We believe Troy Trailers to be the coming transportation for economy."

In either long or short haul work you utilize the full load moving ability of your truck by hauling from twice (sometimes more) its rated load by attaching Troy Trailers—insingle units or in trains.

It costs only 25 per cent more to haul ten tons—half on a five-ton truck and half on a five-ton Troy Trailer—than it does to haul five tons on the truck alone.

Seventy-five per cent saving on the second load—and the important time and labor saving of making one trip and one crew do the work of two.

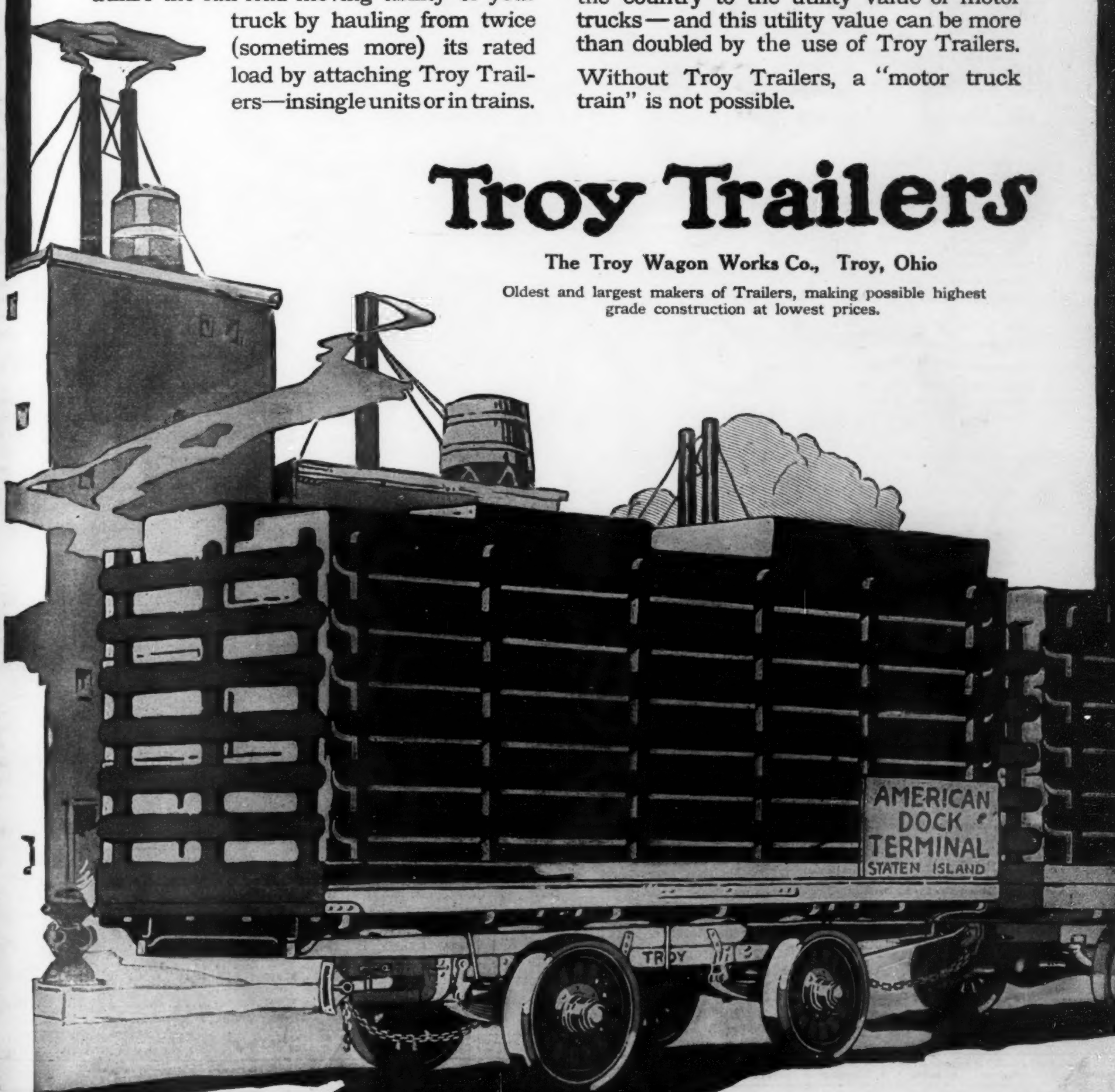
War-time congestion of railroads is waking the country to the utility value of motor trucks—and this utility value can be more than doubled by the use of Troy Trailers.

Without Troy Trailers, a "motor truck train" is not possible.

Troy Trailers

The Troy Wagon Works Co., Troy, Ohio

Oldest and largest makers of Trailers, making possible highest grade construction at lowest prices.



Price Classification of Motor Cars for 1918

Tabulation of American-Made Gasoline Passenger Cars, Showing Six Price Divisions for Easy Reference

Compiled by the SCIENTIFIC AMERICAN

The accompanying table is presented with the object of showing at a glance which cars are within certain price limits. The data were supplied by the manufacturers whose names are mentioned, and a few omissions have been made only because the desired information was not received in due time. For an explanation of the abbreviations used, see note at the bottom of this page.

Name of car	Names and Address of Manufacturer	Under $600	$600 to $999	$1,000 to $1,999	$2,000 to $2,999	$3,000 to $3,999	$4,000 or over
Abbott	Abbott Corp., Cleveland, Ohio			6, 60, r, t, $1,095	6, 60, s, c, $2,150		
Allen	Allen Motor Co., Fostoria, O.			4, 32, r, t, s, c, $1,095			
American Six	American Motors Corp., Plainfield, N. J.			6, 23.4, t, $1,375 r, $1,465			
Dumore	American Motor Vehicle Co., Lafayette, Ind.	4, 12, r, $385					
Anderson	Anderson Motor Co., Rock Hill, S. C.			6, 25.35, t, r, $1,435	6, 25.35, s, $2,100		
Apperson	Apperson Bros. Auto. Co., Kokomo, Ind.				8, 58, r, t, s, $2,550 6, 48, r, t, s, $2,200		
Arbens	Arbens Car Co., Chillicothe, Ohio		4, 25, t, $750				
Auburn	Auburn Auto Co., Auburn, Ind.			6, 23.4, r, t, $1,145 6, 23.4, s, $1,320 6, 29.4, t, $1,535 6, 29.4, s, $1,785			
Austin	Austin Auto Co., Grand Rapids, Mich.					12, 39.6, r, t, $3,750	12, 39.6, s, $4,950 12, 39.6, l, $5,250
Owen Magnetic	Baker R. & L. Co., Cleveland, Ohio					6, 28, t, $3,300 6, 28, c, $3,500 6, 33, t, r, $3,950	6, 28, l, $4,350 6, 28, l,, $4,550 6, 33, l, $5,000 6, 33, lan, $5,200 6, 39, t, $,5300 6, 39, s. l, $6,300
Roamer	Barley Motor Car Co., Kalamazoo, Mich.				6, —, r, t, l, s, tc, $2,250 4, —, r, t, l, s, tc, $2,25	6, —, t, $3,550 0.	
Glide	Bartholomew Co., Peoria, Ill.			6, 40, t, $1,495 6, 40, s, $1,795			
Bell	Bell Motor Car Co., York, Pa.		4, 19.6, t, $895				
Ben Hur	Ben Hur Motor Co., Willoughby, Ohio			6, 29.4, t, $1,875			
Biddle	Biddle Motor Car Co., Philadelphia, Pa.				4, 22.5, r, $2,600 4, 22.5, t, $2,650	4, 22.5, b, $3,900 4, 26, t, $3,600	4, 22.5, tc, $4,000
Birch	Birch Motor Cars, Inc., Chicago, Ill.		4, 35, r, t, $895	6, 40, t, $1,085			
Brewster	Brewster & Co., New York City						4, 30, ph, $7,700 4, 30, b, $8,300 4, 30, lan, $8,400 4, 30, l, $8,500
Briscoe	Briscoe Motor Corp., Jackson, Mich.		4, 16, r, t, $725				
Buick	Buick Motor Co., Flint, Mich.		4, 35, r, t, $795	6, 60, r, t, $1,265 6, 60, t, $1,495 6, 60, c, $1,695	6, 60, s, $2,175		
Bush	Bush Motor Co., Chicago, Ill.		4, 35, t, $875				
Cadillac	Cadillac Motor Car Co., Detroit, Mich.				8, 31.25, t, r, ph, $2,805	8, 31.25, v, $3,205 8, 31.25, b, $3,650	8, 31.25, l, $4,145 8, 31.25, lan, $4,295
Cameron	Cameron Motor Co., Stamford, Conn.			6, 36, r, t, $1,200			
Case	J. I. Case Threshing Machine Co., Racine, Wis.			6, 50, r, t, $1,875	6, 50, s, $2,375		
Chalmers	Chalmers Motor Car Co., Detroit, Mich.			6, 24.3, r, t, $1,485 6, 24.3, t, $1,535 6, 24.3, cab, $1,775 6, 24.3, s, $1,950	6, 24.3, l, tc, $2,925	6, 24.3, lan, $3,025	
Chandler	Chandler Motor Car Co., Cleveland, Ohio			6, 29.4, r, t, $1,595	6, 29.4, c, $2,195 6, 29.4, s, $2,295 6, 29.4, l, $2,895		
Chevrolet	Chevrolet Motors Co., New York City		4, 26.6, r, $620 4, 26.6, t, $635 4, 30, r, t, $935	4, 26.6, c, s, $1,060 4, 30, s, $1,475 8,45, r, t, $1,385			
Coey Flyer	Coey Motor Co., Chicago, Ill.		4, —, r, t, $695				
Cole	Cole Motor Car Co., Indianapolis, Ind.			8, 39.22, t, r, $1,995	8, 39.22, t, r, $2,395 8, 39.22, c, $2,495 8, 39.22, s, $2,695		
Columbia	Columbia Motors Co., Detroit, Mich.			6, 40, t, $1,350, $1,495			
Comet	Comet Auto Co., Decatur, Ill.			6, 50, t, $1,285			
Commonwealth	Commonwealth Motors Co., Chicago, Ill.		4, 40, r, t, $995				
Hatfield	Cortland Cart and Carriage Co., Sidney, N. Y.		4, 22.5, r, $950	4, 22.5, t, $1,080 4, 22.5, r, $1,090			
Crawford	Crawford Auto Co., Hagerstown, Md.				6, 40, r, t, $2,250 6, 40, s, $2,750		
Crow-Elkhart	Crow-Elkhart Motor Co., Elkhart, Ind.		4, 34.9, r, t, $935				
Cruiser	Cruiser Motor Car Co., Madison, Wis.			6, 35, r, t, $1,075			
Cunningham	James Cunningham Son & Co., Rochester, N. Y.						8, 45, r, t, $4,250 8, 45, l, $5,500
Daniels	Daniels Motor Car Co., Reading, Pa.					8, 33.8, r, t, $3,100 8, 33.8, s, etc,. apply	
Davis	Geo. W. Davis Motor Car Co., Richmond, Ind.			6, 25.35, t, r, $1,485 6, 25.35, s, $1,850 6, 29.39, t. r, $1,785			
Detroiter	Detroiter Motors Co., Detroit, Mich.			6, 40, r, t, l, $1,395			
Dispatch	Dispatch Motor Car Co., Minneapolis, Minn.			4, 30, r, $1,150 4, 30, t, $1,250 4, 30, c, s, $1,400			
Dixie Flyer	Dixie Motor Car Co., Louisville, Ky.	4, 22.5, r, t, c, s; Pric	es on application				
Dodge	Dodge Bros., Detroit, Mich.		4, 30, r, t, $885	4, 30, r, t, $1,050 4, 30, s, c, $1,350			
Dorris	Dorris Motor Car Co., St. Louis, Mo.	6, 38.4, r, t, l;. Prices	on application				
Dort	Dort Motor Car Co., Flint, Mich.		4, 16.9, t, r, $725	4, 16.9, s, $1,095			
Drummond	Douglas Motors Corp., Omaha, Neb.				8, 80, r, t, $2,000		
Dunn	Dunn Motor Works, Ogdensburg, N. Y.	4, 14.5, r, $295					
Gem	Duryea Motors, Inc., Philadelphia, Pa.	2, 14, $250 (Three-whe	el car)				
Eagle	Eagle Macomber Motor Car Co., Sandusky, Ohio			5, 28, t, $1,500 5, 28, s, $1,850			
Economy	Economy Motor Co., Tiffin, Ohio		4, 36.9, t, $985	4, 36.9, r, $1,040 8, 48, r, t, $1,395			
Elgin	Elgin Motor Car Corp., Chicago, Ill.			6, 30, r, t, $1,095 6, 30, s, $1,645			
Elcar	Elkhart Carriage and Motor Car Co., Elkhart, Ind.			4, 35, r, t, s, $1,095 6, 35, r, t, s, $1,295			
Empire	Empire Auto Co., Indianapolis, Ind.			4, 24.6, t, $1,125 4, 24.6, r, $1,165 6, 25.4, t, $1,345 6, 25.4, s, $1,685			
Erie	Erie Motor Car Co., Painesville, Ohio		4, 23, r, t, $850				
Fageol	Fageol Motors Co., Oakland, Cal.						6, 125, ch, $10,000
Fiat	F. I. A. T., Poughkeepsie, N. Y.						4, 42, t, $5,500 4, 42, s, $6,500
Ford	Ford Motor Co., Detroit, Mich.	4, 22.5, r, $345 4, 22.5, t, $360 4, 22.5, c, $560	4, 22.5, s, $695				
Franklin	H. H. Franklin Mfg. Co., Syracuse, N. Y.				6, 25.4, r, $2,000 6, 25.4, t, $2,050	6, 25.4, l, $3,200	4, 135, racer, $7,500
Frontenac	Frontenac Motor Co., Plainfield, N. J.						
Ghent	Ghent Motor Co., Ottawa, Ill.			6, 60, r, t, $1,875	6, 60, s, $2,475		
Grant	Grant Motor Car Corp., Cleveland, Ohio			6, 21.6, r, t, $1,055 6, 21.6, s, $1,350, $1,595 6, 21.6, c, $1,575			
Hackett	Hackett Motor Car Co., Jackson, Mich.		4, 22.5, t, $960				
Hal	Hal Motor Car Co., Cleveland, Ohio					12, 39.6, r, t, $3,500 12, 39.6, t, $3,750	12, 39.6, s, $4,500 12, 39.6, l, t, $5,000
Halladay	Halladay Motor Car Co., Mansfield, Ohio			6, 21.6, t, $1,150 6, 23.4, t, $1,385			
Harroun	Harroun Motors Corp., Detroit, Mich.		4, 43, t, $785				
Harvard	Harvard-Pioneer Motor Car Corp., Troy, N. Y.		4, 22.2, r, $750, $985				
Haynes	Haynes Auto Co., Kokomo, Ind.			6, 29.4, t, $1,725 6, 29.4, r, t, $1,825	6, 29.4, c, $2,535 6, 29.4, s, $2,585 12, 36.3, r, t, $2,785	6, 29.4, tc, $3,250 12, 36.3, c, $3,335 12, 36.3, s, $3,385 12, 36.3, tc, $3,985	
Howard	A. Howard Co., Galion, Ohio			6, 50, r, t, $1,800			
Hudson	Hudson Motor Car Co., Detroit, Mich.			6, 29.4, ph, $1,950	6, 29.4, lan, $2,350 6, 29.4, s, $2,750	6, 29.4, l, $3,150 6, 29.4, l, tc, $3,400 6, 29.4, lan, tc, $3,500	6, 29.4, lan, $4,250
Hupmobile	Hupp Motor Car Corp., Detroit, Mich.			4, —, r, t, $1,250			
Inter-State	Inter-State Motor Co., Muncie, Ind.		4, 19.6, r, $875, $950 4, 19.6, t, $925				
Jackson	Jackson Automobile Co., Jackson, Mich.			8, 28.8, r, t, $1,495 8, 28.8, t, $1,570	8, 28.8, s, $2,195		
Jones	Jones Motor Car Co., Wichita, Kan.			6, 60, r, t, $1,675 6, 60, v, $1,775	6, 60, s, $2,550		
Jordan	Jordan Motor Car Co., Cleveland, Ohio			6, 29.4, t, $1,995	6, 29.4, s, $2,850	6, 29.4, b, $3,000 6, 29.4, tc, $3,300 6, 29.4, l, $3,500	
King	King Motor Car Co., Detroit, Mich.			8, 28.8, r, $1,585 8, 28.8, t, $1,650,	8, 28.8, s, $2,300		
Kissel Kar	Kissel Motor Car Co., Hartford, Wis.			6, 52, r, t, $1,295, $1,385 6, 52, s, c, $1,735 6, 52, s, $1.885	6, 52, v, $2,050 12, 82, r, t, $2,250 12, 82, s, c, $2,650 12, 82, s, $2,800		

Key: First figure gives number of cylinders; second gives horse-power—S. A. E. ratings in italics, manufacturers' ratings in roman; prices given are for cars with bodies indicated by letters as follows:
r roadster *t* touring car *s* sedan *l* limousine *b* brougham *c* coupe *ph* phaeton *tc* town car *lan* landaulet *cab* cabriolet *v* victoria *ch* chassis only

(Continued on page 32)

Price Classification of Motor Cars for 1918—Concluded

Name of car	Name and Address of Manufacturer	Under $600	$600 to $999	$1,000 to $1,999	$2,000 to $2,999	$3,000 to $3,999	$4,000 or over
Kline Kar	Kline Car Corp., Richmond, Va.			6, 38, *r*, *t*, $1,495	6, 38, *s*, $2,195		
Homer Laughlin	Homer Laughlin Engineering Corp., Los Angeles, Cal.			8, *16.25*, *r*, $1,050			
Laurel	Laurel Motors Co., Anderson, Ind.			4, 55, *r*, *t*, $1,095			
Lenox	Lenox Motor Car Co., Hyde Park, Mass.				6, *33*, *t*, $2,650		
Hollier	Lewis Spring and Axle Co., Chelsea, Mich.			6, *25.35*, *t*, $1,285 8, *28.8*, *t*, $1,285			
Lexington	Lexington Motor Co., Connersville, Ind.			6, 40, *t*, $1,585 6, 40, *s*, $1,785			
Liberty	Liberty Motor Car Co., Detroit, Mich.			6, *25.4*, *r*, *t*, $1,350 6, *25.4*, *s*, $1,925	6, *25.4*, *b*, *lan*, $2,700		
Locomobile	Locomobile Co. of America, Bridgeport, Conn.						6, *38*, *t*, $5,000 6, *48*, *t*, $5,950
Losier	Losier Motor Co., Detroit, Mich.	4, *28.9* and 6, *36*; apply	for further informati	on			
Luverne	Luverne Auto Co., Luverne, Minn.			6, 42, *t*, *r*, $1,650			
McFarlan	McFarlan Motor Co., Connersville, Ind.					6, *47.6*, *r*, *t*, $3,500	6, *47.6*, *l*, *etc.* $4,600 u
Madison	Madison Motors Corp., Anderson, Ind.			6, 45, *r*, *t*, $1,485			
Maibohm	Maibohm Motors Co., Racine, Wis.		4, *15.6*, *r*, $795 6, *23.4*, *r*, *t*, $975	4, *15.6*, *c*, $1,095 6, *23.4*, *s*, *c*, $1,375			
Master	Master Motor Car Co., Cleveland, O.						6,100, *r*, *t*, *l*, $5,000
Maxwell	Maxwell Motor Co., Detroit, Mich.		4, *21*, *t*, $745				
Mercer	Mercer Auto Co., Trenton, N. J.					4, *22.5*, *t*, *r*, $3,500	
Mets	Mets Co., Waltham, Mass.		4, 25, *r*, *t*, $695				
Mitchell	Mitchell Motors Co., Racine, Wis.			6, 40, *r*, *t*, $1,250 6, 40, *c*, $1,850 6, 40, *s*, $1,950 6, 48, *r*, $1,490, $1,560 6, 48, *t*, $1,525 6, 48, *cab*, $1,960	6, 48, *c*, $2,135 6, 48, *s*, $2,185, $2,275 6, 48, *l*, *tc*, $2,850		
Moline-Knight	Moline Auto Co., East Moline, Ill.			4, 40, *r*, *t*, $1,575 4, 50, *r*, *t*, $1,950	4, 40, *s*, $2,280		
Stephens	Moline Plow Co., Moline, Ill.			6, 57, *r*, *t*, $1,485 6, 57, *t*, $1,550 6, 57, *s*, $1,985			
Monitor	Monitor Motor Car Co., Columbus, Ohio.		4, 30, *r*, *t*, $995	6, 40, *r*, *t*, $1,195			
Monroe	Monroe Motor Co., Pontiac, Mich.		4, *14.5*, *r*, $635 4, *14.5*, *s*, $965	4, *16.9*, *t*, $1,095			
Moon	Moon Motor Car Co., St. Louis, Mo.			6, 36, *t*, $1,195 6, 45, *t*, *r*, $1,685 6, 66, *t*, *r*, $1,850	6, 45, *cab*, $2,350 6, 66, *s*, *c*, $2,650		
Moore	Moore Motor Vehicle Co., Minneapolis, Minn.	4, 36, *t*, $550					
Murray	Murray Motor Car Co., Pittsburgh, Pa.				8, *33.8*, *r*, *t*, $2,800	8, *33.8*, *cab*, $3,600,	8, *33.8*, *l*, $4,000
Marion-Handley	Mutual Motors Co., Jackson, Mich.			6, *29.6*, *t*, $1,850			
Nash	Nash Motors Co., Kenosha, Wis.			6, *25.35*, *t*, *r*, $1,295 6, *25.35*, *s*, $1,985 6, *29.4*, *t*, $1,465			
National	National Motor Car and Vehicle Co., Indianapolis, Ind			6, 55, *r*, *t*, *ph*, $1,995	12, 77, *r*, *t*, *ph*, $2,595 6, 55, *s*, $2,820	12, 77, *s*, $3,420	
Nelson	E. A. Nelson, Detroit, Mich.			4, *15.62*, *r*, $1,200 4, *15.62*, *t*, $1,400			
Marmon	Nordyke & Marmon Co., Indianapolis, Ind.					6, *33.75*, *r*, *t*, $3,550	6, *33.75*, *s*, *l*, *etc.*; apply for prices
Norwalk	Norwalk Motor Car Co., Martinsburg, W. Va.		4, 30, *t*, $965	6, 40, *t*, $1,075			
Oakland	Oakland Motor Car Co., Pontiac, Mich.		6, 44, *r*, *t*, $990	6, 44, *c*, $1,190, $1,490 6, 44, *s*, $1,150			
Ogren	Ogren Motor Works, Inc., Chicago, Ill.	6, *33.8*; Prices on app	lication				
Oldsmobile	Olds Motor Works, Lansing, Mich.			6, *18.9*, *r*, *t*, $1,185 6, *18.9*, *s*, $1,695 6, *18.9*, *c*, $1,595 8, *26.4*, *r*, *t*, $1,467 8, *26.4*, *r*, $1,550			
Olympian	Olympian Motors Co., Pontiac, Mich.		4, *16.9*, *r*, *t*, $965				
Packard	Packard Motor Car Co., Detroit, Mich.					12, *42.3*, *r*, *t*, *ph*, $3,700	12, *42.3*, *t*, $4,100 12, *42.3*, *l*, *s*, *c*, *b*, *etc.*, $5,050-$5,800
Paige	Paige-Detroit Motor Car Co., Detroit, Mich.			6, *23.4*, *r*, *t*, $1,330 6, *23.4*, *s*, $1925 6, *29.4*, *r*, *t*, $1,775	6, *29.4*, *s*, *c*, $2,850	6, *29.4*, *l*, *tc*, $3,230	
Pan-American	Pan-American Motor Corp., Decatur, Ill.			6, 40, *r*, *t*, $1,500			
Paterson	N. A. Paterson Co., Flint, Mich.			6, 25, *r*, *t*, $1,295 6, 25, *s*, $1,795			
Pathfinder	Pathfinder Motor Co. of America, Indianapolis, Ind.					12, *39.6*, *r*, *t*, $3,250	
Peerless	Peerless Motor Car Co., Cleveland, Ohio				8, 80, *r*, *t*, $2,340 8, 80, *c*, $2,850 8, 80, *s*, $2,990	8, 80, *l*, $3,690	
Pennsy	Pennsylvania Motor Car Co., Pittsburgh, Pa.			4, *21.6*, *r*, *t*, $1,065 6, *25.6*, *r*, *t*, *l*, $1,435			
Phianna	Phianna Motors Co., Newark, N. J.						4, 25, *t*, $5,000
Piedmont	Piedmont Motor Car Co., Lynchburg, Va.		4, 30, *r*, *t*, $765	6, 40, *r*, *t*, $1,385			
Pierce-Arrow	Pierce-Arrow Motor Car Co., Buffalo, N. Y.					6, *38*, *r*, *t*, $4,800	6, *38*, *b*, *c*, $5,900 6, *48*, *r*, *t*, *b*, *l*, $5,400-$6,800 6, *66*, *r*, *t*, *b*, *l*, $6,400-$8,000
Pilgrim	Pilgrim Motor Car Co., Detroit, Mich.		4, *22.5*, *t*, *r*, $895				
Pilot	Pilot Motor Car Car Co., Richmond, Ind.			6, 45, *r*, *t*, $1,295			
F. R. P.	Finley R. Porter Co., Pt. Jefferson, N. Y.						4, *34*, *ch*, $7,000
Premier	Premier Motor Corp., Indianapolis, Ind.				6, *27*, *r*, *t*, $2,285	6, *27*, *l*, $3,285	
Princess	Princess Motor Car Corp., Detroit, Mich.		4, *22.5*, *r*, *t*, $825				
Pullman	Pullman Motor Car Corp., York, Pa.	4, *22.6*, ; Prices on ap	plication				
Regal	Regal Motor Car Co., Detroit, Mich.		4, 32, *t*, $795				
Reo	Reo Motor Car Co., Lansing, Mich.		4, 35, *r*, *t*, $985	6, 40, *r*, *t*, $1,385			
Ri-Chard	Ri-Chard Auto Mfg. Co., Cleveland, Ohio						4, 90, *t*, $4,500 8, 120, *t*, $8,000
Ross	Ross Auto Co., Detroit, Mich.			8, 80, *r*, *t*, $1,850			
Yale	Saginaw Motor Car Co., Saginaw, Mich.			8, *28.8*, *r*, *t*, $1,885			
Saxon	Saxon Motor Car Corp., Detroit, Mich.	4, 18.5, *r*, $445	6, 36, *r*, *t*, $935	6, 36, *s*, $1,395			
Scripps-Booth	Scripps-Booth Corp., Detroit, Mich.	4 and 8; apply for fur	ther information				
Bour-Davis	Shadburne Bros. Co., Chicago, Ill.			6, 66, *t*, $1,650			
Shad-Wyck	Shadburne Bros. Co., Chicago, Ill.				6, 66, *t*, $2,650		
Simplex	Simplex Auto Co., New York City						6, *46*, *ch*, $7,000
Singer	Singer Motor Co., New York City					6, *38.4*, *t*, 3,800	6, *38.4*, *r*, $4,000 6, *38.4*, *l*, $4,750 6, *38.4*, *b*, $5,350
Standard	Standard Steel Car Co., Pittsburgh, Pa.				8, *33.8*, *r*, *t*, $2,450	8, *33.8*, *s*, *c*, $3,500	8, *33.8*, *l*, $4,000
States	States Motor Car Co., Kalamazoo, Mich.		4, 32, *t*, $895 6, 37, *t*, $995	6, 37, *l*, $1,195			
Stearns	F. B. Stearns Co., Cleveland, Ohio			4, *22.5*, *r*, *t*, $1,785	8, *33.8*, *r*, *t*, $2,575	4, *22.5*, *l*, $3,200 8, *33.8*, *l*, $3,875	
Studebaker	Studebaker Corp. of America, South Bend, Ind.			4, *24.03*, *r*, $1,025 4, *24.03*, *t*, $1,050 4, *36.04*, *r*, $1,335 4, *36.04*, *t*, $1,385			
Stutz	Stutz Motor Car Co. of America, Indianapolis, Ind.				4, *30.6*, *r*, $2,550 4, *30.6*, *c*, $2,650 4, *30.6*, *t*, $2,750		
Thomas	E. R. Thomas Motor Car Co., Buffalo, N. Y.						6, 40, *t*, $4,000 6, 40, *l*, $4,500 6, 70, *l*, $5,000
Great Eagle	U. S. Carriage Co., Columbus, Ohio					4, 50, *l*, $3,500 up 6, 60, *l*, $3,750 up	
Velie	Velie Motors Corp., Moline, Ill.			6, *25.4*, *r*, *t*, $1,340 6, *25.4*, *cab*. $1,800 6, *25.4*, *c*, $1,850 6, *25.4*, *s*, $1,885 6, *29.6*, *t*, $1,595	6, *25.4*, *tc*, $2,450		
Victor	Victor Motor Co., York, Pa.		4, 32, *t*, $795				
Westcott	Westcott Motor Car Co., Springfield, Ohio			6, *29.4*, *r*, $1,890 6, *29.4*, *t*, $1,940	6, *29.4*, *s*, *c*, $2,790		
White	White Co., Cleveland, Ohio						4, 70, *r*, *t*, $5,000 4, 70, *tc*, *s*, *c*, $6,050 4, 70, *l*, *lan*, $6,200 6, 70, *cab*, $6,400
Overland	Willys Overland Co., Toledo, Ohio		4, 32, *r*, $780 4, 32, *t*, $795 4, 35, *r*, $915 4, 35, *t*, $930	4, 32, *t*, $1,240 6, 37, *r*, $1,115 6, 37, *t*, $1,330 6, 37, *c*, $1,420 6, 37, *s*, $1,620			
Willys	Willys Overland Co., Toledo, Ohio			6, 45, *t*, $1,365	6, 45, *s*, $2,045		
Willys-Knight	Willys Overland Co., Toledo, Ohio			4, 40, *t*, $1,525	4, 40, *c*, $2,175 8, 65, *t*, $2,000 8, 65, *s*, $2,700 8, 65, *l*, *tc*, $2,800		
Winton	Winton Co., Cleveland, Ohio				6, *33.75*, *r*, *t*, $2,950	6, *33.75*, *t*, $3,000 6, *33.75*, *c*, *l*, $3,950 6, *48.6*, *r*, *t*, $3,500	6, *33.75*, *l*, *lan*, *s*, $4,300 6, *48.6*, *c*, *l*, $4,500 6, *48.6*, *l*, *lan*, *s* $4,700
Wolverine	Wolverine Motor Car Co., Kalamazoo, Mich.					4, 90, *r*, $3,500	
Woods	Woods Mobilette Mfg. Co., Harvey, Ill.	4, 22, *r*, $405					
Woods Dual	Woods Motor Vehicle Co., Chicago, Ill.	(Runs on either gasolin	e or electricity)		4, 40, *c*, $2,950		

(Continued on page 34)

Clydesdale MOTOR TRUCKS

Tested in the Crucible of War—and Found Fit

The Clydesdale Motor Truck has met the harshest tests of all time—the tests of the great European war—*and has conquered.* Nearly three years ago this truck, which was efficiently performing its peaceful duties here, was selected for war service in Europe.

The keenest engineering minds of France, England and America met and in joint conference made certain changes in its construction to enable it to meet better the super strains of war service. As a result it now embodies the best practices of these three nations—combining the refinements of European design with the advantages of American manufacturing methods.

Production was rushed and hundreds of trucks have been sent abroad. Continuous repeat orders are eloquent evidence of the service the Clydesdale is rendering. It has been tested in the crucible of war—*and found fit.* It has satisfied the most critical group of men in the world—the army truck drivers of the Allies.

But traffic managers in this country are *equally enthusiastic* over its performance in *peaceful commerce.* The Clydesdale embodies important and exclusive features—features that have proved their value in both war and peace.

Prominent among them is the Krebs Patented Automatic Controller. This device is not an ordinary *governor*, but an *exclusive patented attachment that practically acts as a second driver.*

It *maintains any speed*—up hill or down, and positively *prevents engine racing.* This feature alone effects a tremendous saving in the life of your entire truck. It also enables a comparatively inexperienced man to handle the Clydesdale efficiently.

Another exclusive feature is the Clydesdale radiator, patterned after the famous London General Omnibus radiator—with a tremendous cooling surface of plain standard copper tubing. It is mounted on the chassis frame on double acting springs, eliminating all excessive jarring and vibration.

Clydesdale transmission is the flexible four-speed type. Final drive is through worm-gear.

The Clydesdale deep pressed steel frame is heavily cross braced, giving ample strength for any emergency. A rugged four cylinder L head motor supplies an abundance of power with a minimum expenditure of fuel. The drive is taken through substantial radius rods. Long chrome vanadium springs give perfect suspension, and all suspension pins are ground accurately to size and operate in bronze bushings.

Each detail of construction is an index to the strength of the entire truck—a strength that has enabled the Clydesdale to win its spurs under conditions far harsher than you will ever impose upon it.

The Clydesdale line is *complete*, ranging in capacity up to five tons.

Ask our dealer to call and demonstrate.

Motor Car Merchants

The Clydesdale line offers you the greatest selling opportunity in the entire commercial car field. Just now particularly, you can greatly increase your business with very little additional capital by taking on the Clydesdale line. We are anxious to add the right type of merchants to our selling organization. If you think you can qualify and want a permanent proposition, write or wire us at once.

The Clyde Cars Co., Clyde, Ohio

Electric Pleasure Cars for 1918

Name of Car	Names and Address of Manufacturer	Passenger Capacity, Type of Body and Prices		
		Under $2,000	$2,000-$2,999	$3,000 and over
Detroit	Anderson Electric Car Co., Detroit, Mich.		3, Brougham, $2,175; 4, Brougham, $2,175, $2,740; 5, Brougham, $2,790-$2,840	
Rauch & Lang	Baker R. & L. Co., Cleveland, Ohio			5, Brougham, $3,000; 5, Coach, $3,200; 6 or 7, Town Car, $4,000
Columbian	Columbian Electric Vehicle Co., Detroit, Mich.	2, Runabout, $1,175; 3, Coupelet, $1,375; 4, Brougham, $1,575		
100-mile Fritchle	Fritchle Electric Co., Denver, Colo.			4, Coupe, $3,200; 5, Coupe, $3,600
Hupp-Yeats	Hupp-Yeats Electric Car Co., Detroit, Mich.	4, Coupe, $1,750	4, Coupe, $2,000	
Milburn	Milburn Wagon Co., Toledo, Ohio	4, Brougham, $1,885	5, Sedan and 7, Limousine: not yet fi	xed, apply
Ohio	Ohio Electric Car Co., Toledo, Ohio		5, Coupe, $2,680	5, Coupe, $3,250
Woods Dual	Woods Motor Vehicle Co., Chicago, Ill.	(Runs on Gasoline or Electricity)	4, Coupe, $2,950	

Tonnage Classification of Commercial Vehicles for 1918

List of American Gasoline Motor Trucks, Showing Carrying Capacities and Prices

Name of Vehicle	Name and Address of Manufacturer	Tons Capacity, Horse-power and Price					
		Under 1 Ton	1-1½ Tons	2-2½ Tons	3-3½ Tons	4-5 Tons	Over 5 Tons
Concord	Abbott & Downing Co., Concord, N. H.		1, 19.6, $1,750	2, 29, $2,400			
Acason	Acason Motor Truck Co., Detroit, Mich.		1½, 22.5, $2,100	2, 28.9, $2,400	3½, 28.9, $3,000	5, 36.1, $4,200	
Acme	Acme Motor Truck Co., Detroit, Mich.				3, 40, $3,500		
Acme	Acme Wagon Co., Emigsville, Pa.	¾, —, $1,350					
American	American Motor Truck Co., Detroit, Mich.		1½, 30, $2,250	2, 30, $2,450	3½, 40, $3,450	5, 50, $4,200	
Dumore	American Motor Vehicle Co., Lafayette, Ind.	¼, 12, $385 and $450					
Armleder	O. Armleder Co., Cincinnati, Ohio			2, 40, $2,750	3½, 47, $3,600		
Atterbury	Atterbury Motor Car Co., Buffalo, N. Y.		1½, 26, $2,275	2, 34.5, $2,675	3½, 42, $3,575		
Autocar	Autocar Co., Ardmore, Pa.		1½, 18, $1,813				
Available	Available Truck Co., Chicago, Ill.		1, 22.5, $1,950	2, 27.6, $1,950	3½, 34.4, $3,650	5, 34.4, $4,600	
Avery	Avery Co., Peoria, Ill.			2, 36.4, $2,700	3, 36.4, $3,200	5, 44.2, $4,500	
Barker	C. L. Barker, Norwalk, Conn.		1½, —, $2,000	2½, —, $2,400			
Beck	Beck & Son, Cedar Rapids, Iowa		1, 19.6, $1,080; 1½, 19.6, $1,275	2, 28.9, $1,750			
Beech Creek	Beech Creek Truck and Auto. Co., Beech Creek, Pa.				3, 29, $3,850		
Bell	Bell Motor Car Co., York, Pa.	½, 32, $970					
Bessemer	Bessemer Motor Truck Co., Grove City, Pa.		1, 25, $1,250	2, 36, $2,200	3½, 45, $3,450		
Bethlehem	Bethlehem Motor Corp., Allentown, Pa.		1¼, 22.5, $1,245	2¼, 25.6, $1,775			
Blair	Blair Motor Truck Co., Newark, Ohio			2, 28.9, $2,850	3, 28.9, $3,250	5, 32.4, $4,250	
Bourne Magnetic	Bourne Magnetic Truck Co., Philadelphia, Pa.			2, 25.6, $3,500	3½, 29.8, $4,200		
Modern	Bowling Green Motor Truck Co., Bowling Green, Ohio		1½, 20, $1,800	2½, 27, $2,250			
Brinton	Brinton Motor Truck Co., Philadelphia, Pa.		1, 25, $1,250	2½, 35, $2,550			
Briscoe	Briscoe Motor Corp., Jackson, Mich.	½, 30, $725	1, 30, $1,000				
Brockway	Brockway Motor Truck Co., Cortland, N. Y.		1½, 22.5, $2,050	2, 27.2, $2,450	3½, 32.4, $3,200		
Buick	Buick Motor Co., Flint, Mich.	¾, 18.2, $790					
Acme	Cadillac Auto Truck Co., Cadillac, Mich.		1, 22.5, $1,750	2, 27.23, $2,450	3½, 32.4, $3,250	4, 32.4, $3,700	
Champion	Champion Motors Co., Cleveland, Ohio	½, 28.3, $825					
Chase	Chase Motor Truck Co., Syracuse, N. Y.		1, 19.61, $1,725; 1½, 19.61, $2,025	2½, 27.2, $2,475	3½, 32.4, $3,600		
Chevrolet	Chevrolet Motor Co., New York City		1, 26.6, $585				
Little Giant	Chicago Pneumatic Tool Co., Chicago, Ill.		1, 19.6, $1,650	2, 27.2, $2,500	3½, 32.4, $3,450		
Clydesdale	Clyde Cars Co., Clyde, Ohio		1, 30, $1,490; 1½, 40, $2,200	2, 40, $2,600	3½, 45, $3,500	5, 45, $4,200	
Collier	Collier, Co., Cleveland, Ohio	¾, 29, $885					
Coey	Coey Motor Co., Chicago, Ill.		1, 30, $650				
Columbia	Columbia Motor Truck and Trailer Co., Pontiac, Mich.			2, 40, $1,950			
Commerce	Commerce Motor Car Co., Detroit, Mich.		1, 19.6, $1,340				
Trojan	Commercial Truck Co., Cleveland, Ohio		1, 18, $1,500				
Thomas	Consolidated Motors Corp., New York City			2 and 3½ ton trucks;	Prices, etc., on applica	tion	
Conestoga	Conestoga Motor Truck Co., Lancaster, Pa.	¾, 22, $890					
Continental	Continental Truck Mfg. Co., Superior, Wis.		1½, 30, $1,850	2½, 35, $2,000	3½, 40, $3.300		
Corbitt	Corbitt Motor Truck Co., Henderson, N. C.		1, 22.5, $1,650; 1½, 22.5, $1,900	2, 27.5, $2,650; 2½, 27.5, $2,900	3½, 32.4, $3,600	5, 32.4, $4,200	
Corliss	Corliss Motor Truck Co., Corliss, Wis.	½, 17, $715					
Hatfield	Cortland Cart and Carriage Co., Sidney, N. Y.	¾, 22.5, $840					
Couple Gear	Couple Gear Freight Wheel Co., Grand Rapids, Mich.				3½, 40, $5,800	5, 60, $6,400	7, 60, $7,000
Croce	Croce Auto Co., Asbury Park, N. J.		1, 22.5, $1,250; 1½, 28.5, $1,500	2, 30, $2,100			
Crowther-Duryea	Crowther Motor Co., Rochester, N. Y.	¾, 22.5, $600					
Dart	Dart Motor Truck Co., Waterloo, Iowa		1, 22.5, $1,850	2, 28.9, $2,470	3½, 32.5, $3,400		
D. E.	Day Elder Motors Corp., Newark, N. J.	¾, 15.6, $950	1, 19.6, $1,495; 1½, 22.5, $1,755	2, 22.5, $1,835; 2½, 29, $2,365			
Dayton	Dayton Motor Truck Co., Dayton, Ohio				3½, 36.1, apply	5, 44.2, apply	7½, 53, apply
De Kalb	De Kalb Wagon Co., De Kalb, Ill.			2, —, $2,100; 2½, —, $2,450			
De Martini	De Martini Motor Truck Co., San Francisco, Cal.		1, 28, $2,250	2, 30, $2,750	3, 35, $3,650	4, 40, $4,250	
Denby	Denby Motor Truck Co., Detroit, Mich.		1, 28, $1,490	2, 38, $2,025	3, 38, $2,525	5, 48, $4,900	
Special Trucks	Detroit Chassis Co., Detroit, Mich.	½, 22, $450	1, 27, $1,250				
Horner	Detroit Wyandotte Motor Truck Co., Wyandotte, Mich.		1½, 27.25, $2,600	2, 27.25, $2,750	3, 36.75, $3,550	5, 46.5, $4,750	
Diamond T	Diamond T Motor Car Co., Chicago, Ill.		1, 19.6, $1,725; 1½, 22.5, $2,200	2, 27.2, $2,475	3½, 32.4, $3,750	5, 32.4, $4,600	
Dispatch	Dispatch Motor Car Co., Minneapolis, Minn.	¾, 30, $1,150					
Doane	Doane Motor Truck Co., San Francisco, Cal.			2½ 29, $3,200			6, 36, $5,000
Dorris	Dorris Motor Car Co., St. Louis, Mo.			2, 28.95, $2,885			
Duplex	Duplex Truck Co., Lansing, Mich.				3½, 40, $3,600		
Economy	Economy Motor Co., Tiffin, Ohio	¾, 36.7, $965					
Elmira	Elmira Commercial Motor Car Co., Owego, N. Y.	½, 18, $350					
E. M. C.	Erie Motor Co., Painesville, Ohio		1, 35, apply				
Fageol	Fageol Motors Co., Oakland, Cal.			2, 28.9, $2,750	3½, 36.1, $3,750	5, 36.1, $4,750	
Famous	Famous Trucks, Inc., St. Joseph, Mich.	½, 29.6, $650					
Fargo	Fargo Motor Car Co., Chicago, Ill.			2, 22.5, $2,200			
Federal	Federal Motor Truck Co., Detroit, Mich.		1, 25, $1,750; 1½, 30, $2,200	2, 30, $2,450	3½, 40, $3,150	5, 40, $4,200	
Ford	Ford Motor Co., Detroit, Mich.		1, 22.5, $600				
Forschler	Forschler Motor Truck Mfg. Co., New Orleans, La.	¾, 22, $1,100	1, 25, $1,900; 1½, 30, $2,200	2, 35, $2,500; 2½, 40, $2,800			
F. W. D.	Four Wheel Drive Auto Co., Clintonville, Wis.				3, 36.1, $4,600		
Fulton	Fulton Motor Truck Co., Farmingdale, N. Y.		1½, 36, $1,420				
Gabriel	Gabriel Motor Truck Co., Cleveland, Ohio		1, 30, $1,750	2, 40, $2,750	3½, 50, $3,750		
Garford	Garford Motor Truck Co., Lima Ohio		1, 19.6, $1,750; 1½, 22.5, $2,100	2, 29, $2,600	3½, 29. $3,700	5, 36.1, $4,500	6, 41.5, $4,700
Gary	Gary Motor Truck Co., Gary, Ind.		1, 30; 1½, 40	2, 45; 2½, 45	3½, 52.5; new prices	on all models in effect	soon; apply
Gem	Gem Motor Car Corp., Grand Rapids, Mich.	½, 32, $700					
G. M. C.	General Motor Truck Co., Pontiac, Mich.	¾, 27, $1,395	1, 31, $1,950; 1½, 31, $2,350	2, 35, $2,690	3½, 42, $3,750	5, 42, $4,350	
Gersix	Gersix Mfg. Co., Seattle, Wash.			2½, 29.85, $2,950			
Globe	Globe Motor Truck Co., E. St. Louis, Ill.		1, 19.61, $1,425; 1½, 22.5, $1,750	2, 27.2, $2,050			
Gramm	Gramm Bernstein Motor Truck Co., Lima, Ohio		1½, 24.7	2½, 34.6	3½, 38.7	5, 50.8; apply for prices	
Grant-Denmo	Grant Motor Car Corp., Cleveland, O.	¾, 27, $1,020	1½, 35, $1,490	2, 35, $1,790	3, 47, $3,325		
Hahn	Hahn Motor Truck and Wagon Co., Hamburg, Pa.	¾, 14.4, $1,100	1½, 27.2, $1,950		3½, 32.4, $2.900		
Panhard	Hamilton Motors Co., Grand Haven, Mich.		1, 35, $895; 1½, 35, $995				
Harvey	Harvey Motor Truck Co., Harvey, Ill.			2½, 29, $2,850	3½, 32.4, $3,850	5, 32.4, $4,600	
Hawkeye	Hawkeye Mfg. Co., Sioux City, Iowa		1½, —, $1,750				
Henderson	Henderson Bros. Co., Cambridge, Mass.	½, 23, $1,275; ¾, 27, $1,695					
Hendrickson	Hendrickson Motor Truck Co., Chicago, Ill.			2, 29, apply	3½, 32.4, $3,000		
Hercules	Hercules Motor Truck Co., Milwaukee, Wis.			2, 29.4, $2,800	3½, 33.7, $3,750	5, 33.7, $4,750	
Hewitt-Ludlow	Hewitt-Ludlow Auto Co., San Francisco, Cal.			2, 22.5, apply	3½, 30, apply		
Higrade	Higrade Motors Co., Buffalo, N. Y.	¾, 20, $1,750	1, 20, $1,800				
Hoover	Hoover Wagon Co., York, Pa.	¾, 23, $1,375					
Hurlburt	Hurlburt Motor Truck Co., New York City		1½, 22.5, $2,600	2, 29, $3,500	3½, 32.4, $4,150	5, 33.75, $5,000	7, 33.75, $6,500
Independent	Independent Motors Co., Pt. Huron, Mich.		1, 19.6, $1,385	2, 27.2, $1,850			
Indiana	Indiana Truck Co., Marion, Ind.		1, 19.6, $1,600	2, 27.2, $3,350	3½, 29, $3,000	5, 41.6, $4,000	
International	International Harvester Corp., Chicago, Ill.	¾, —, $1,450	1, —, $1,750; 1½, —, $2,100	2, —, $2,500			
Mack	International Motor Co., New York City		1, 25.6, $2,400; 1½, 25.6, $2,800	2, 25.6, $3,000	3½, 40, $4,250		5½, 40, $4,750; 7½, 40, $5,000
Inter-State	Inter-State Motor Co., Muncie, Ind.	¾, 35, $925					
Kearns	Kearns Motors Co., Beavertown, Pa.	½, 16.9, $850					
Kelly-Springfield	Kelly-Springfield Motor Truck Co., Springfield, Ohio		1½, 22.5, $2,500	2½, 22.5, $3,000	3½, 32.4, $3.850	4, 32.4, $4,000; 5, 32.4, $4,600	6, 32.4, $4,750
Old Hickory	Kentucky Wagon Mfg. Co., Louisville, Ky.	¾, 30, $875					
King	A. R. King Mfg. Co., Kingston, N. Y.				3½, 32.4, $3,000		
Kissel	Kissel Motor Car Co., Hartford, Wis.		1, 32, $1,185; 1½, 32, $1,585	2½, 37, $2,275		4, 37, $3,150	
Kleiber	Kleiber & Co., Inc., San Francisco., Cal.		1, 22.5, $2,100; 1½, 27.2, $2,500	2, 27.2, $2,750; 2½, 32.4, $3,200	3½, 32.4, $3,850	5, 44.1, $4,900	
Klemm	E. R. Klemm, Chicago, Ill.						6, 60, $4,850
Koehler	H. J. Koehler Motors Corp., Newark, N. J.		1¼, 35, $1,150				
K. T. T.	Kuhn Tractor Truck Co., Seattle, Wash.					5, 28.9, $5,000	
Lane	Lane Motor Truck Co., Kalamazoo, Mich.		1½, 22, $1,750	2, 29, $2,500	3½, 33, $3,250		

(Continued on page 36)

Standard One Ton Smith Form-a-Truck with Ford Power Plant. Armour & Company, Chicago

Universal One Ton Smith Form-a-Truck with Studebaker Power Plant, C. J. Lawrence & Bros., Chicago

Universal One Ton Smith Form-a-Truck with Overland Power Plant, White Eagle Coal Co., Chicago

Universal One Ton Smith Form-a-Truck with Cadillac Power Plant, Jas. McCredie, Elgin, Ill.

Universal One Ton Smith Form-a-Truck with KisselKar Power Plant. Rock Island Fuel Co., Davenport, Iowa

You Can Now Get a Universal Smith Form-a-Truck For Any Make of Car

Deliveries Now Being Made

Universal Means:—

—this Universal Smith Form-a-Truck will make any new or used automobile, with straight side channel-steel frame, with or without single or double drop, into a one or two ton motor truck chassis.

—it answers **your** question of what to do with **your** used car—70% of all used cars are "second hand" because of **style,** not by reason of mechanical decadence.

—you know your old car is **"right"** but your family want appearance—they won't ride in it.

—you can't get the price you know it is **worth**—but you **can** make it pay back the entire original cost and more.

—sell it to your business—let it **earn** from five to seven and a half dollars a day **net** as a motor truck.

—in five hours, by the watch, your used car is taken off your hands and your motor truck is running.

—in two years service it pays for itself and your new car as well.

—30,000 owners have already proved that Smith Form-a-Truck gives the highest truck efficiency and "the Lowest Hauling Cost in the World."

—these owners all used Ford power plants.

—today you can use any power plant. You know how good **your** power plant is. Put it at work.

One-Ton Universal	**$400**
Two-Ton Universal	**500**
One-Ton Standard (for Ford Cars)	**350**

Prices f. o. b. Chicago

Write Us About Your Used Car

SMITH MOTOR TRUCK CORPORATION
Michigan Avenue at Sixteenth St., Chicago, Illinois

List of American Gasoline Motor Trucks, Showing Carrying Capacities and Prices—Continued

Name of Vehicle	Name and Address of Manufacturer	Tons Capacity, Horse-power and Price: Under 1 Ton	1-1½ Tons	2-2½ Tons	3-3½ Tons	4-5 Tons	Over 5 Tons
Lange	Lange Motor Truck Co., Pittsburgh, Pa.		1½, 23, $1,950	2½, 28, $2,650			
Larrabee	Larrabee-Deyo Motor Truck Co., Binghamton, N. Y.		1, 23, $1,800 1½, 27.2, $2,200	2½, 27.2, $2,700	3½, 32.4, $3,400		
Lawson	Lawson Mfg. Co., Pittsburgh, Pa.	½, 22.5, apply					
Hall	Lewis-Hall Iron Works, Detroit, Mich.			2, 32, $2,350	3½, 45, $3,250	5, 45, $4,200	
Lippard-Stewart	Lippard-Stewart Motor Car Co., Buffalo, N. Y.	¾, 30, $1,900	1, 30, $2,150 1½, 35, $2,550	2, 35, $2,850			
Riker	Locomobile Co. of America, Bridgeport, Conn.				3, 28.9, apply	4. 28.9, apply	
Dependable	Lumb Motor Truck and Tractor Co., Aurora, Ill.			2¼, 28.9, $1,900			
Maccar	Maccar Truck Co., Scranton, Pa.		1½, 33, $2,400	2½, 36, $2,950	3½, 36, $3,600		5½, 42, $4,500
Manly	Manly Motor Corp., Waukegan, Ill.		1½, 30, $2,050	2, 30, $2,250 2½, 36, $2,600	3, 42, $3,000		
Atlas	Martin Truck and Body Corp., York, Pa.	¾, 16.9, $885					
Master	Master Trucks, Inc., Chicago, Ill.			2, 29, $1,990			
Maxwell	Maxwell Motor Co., Detroit, Mich.		1, 25, $985				
Menominee	Menominee Motor Truck Co., Menominee, Mich.	¾, 22.5, $1,425	1, 22.5, $1,790 1½, 22.5, $2,050	2, 27.23, $2,475	3½, 32.4, $3,275	5, 32.4, $4,150	
Evans	Merchant & Evans Co., Philadelphia, Pa.			2, 30, $3,000			
Metz	Metz Co., Waltham, Mass.	½, 25, $550					
Ellsworth	Mills-Ellsworth Co., Keokuk, Iowa	½, 16.9, $695					
Mogul	Mogul Motor Truck Co., St. Louis, Mo.		1½, 22.5, apply	2, 27.2, apply 2½, 27.2	3½, 32.5, apply		6, 44, apply
Moon	Jos. W. Moon Buggy Co., St. Louis, Mo.		1½, 35, $1,650	2, 40, $2,750			
Moreland	Moreland Motor Truck Co., Los Angeles, Cal.		1, 22.5, $2,050 1½, 27.3, $2,750	2½, 32.5, $3,375		4, 36.1, $4,150 5, 36.1, $5,000	
Muskegon	Muskegon Engine Co., Muskegon, Mich.			2, 27.2, $1,995	3½, 32.4, $3,400		
Wisconsin	Myers Machine Co., Sheboygan, Wis.		1½, 36, $1,650	2½, 33, $2,500		5, 50, $5,000	
Nash	Nash Motors Co., Kenosha, Wis.		1, 22.5, $1,495	2, 22.5, $1,875 2, 28.9, $3,250			
Nelson & Le Moon	Nelson & Le Moon, Chicago, Ill.		1, 22, $1,700	2, 27, $2,250	3, 34, $2,950	5, 36, $3,750	
Netco	New England Truck Co., Fitchburg, Mass.			2, 30, $2,800			
Moeller	New Haven Truck and Auto Works, New Haven, Conn		1½, 32, $2,500		3, 35, $3,000	5, 45, $4,500	
Niles	Niles Car and Mfg. Co., Niles, Ill.		1, 19.6, $1,500	2, 27.25, $2,400			
Noble	Noble Motor Truck Co., Kendallville, Ind.			2, 40, $2,300			
Norwalk	Norwalk Motor Car Co., Martinsburg, W. Va.	½, 28, $875	1, 35, $1,295				
Old Reliable	Old Reliable Motor Truck Co., Chicago, Ill.		1½, 24, $1,950	2, 30, $2,500	3, 35, $3,250	4, 45, $3,750 5, 45, $4,250	7, 50, $5,000
Oneida	Oneida Motor Truck Co., Green Bay, Wis.		1, 22.5, $2,290 1½, 22.5, $2,650	2, 27.23, $3,000	3½, 32.4, $3,600		
Packard	Packard Motor Car Co., Detroit, Mich.		1, 25.6, $2,450 1½, 25.6, $2,800	2, 25.6, $3,200	3, 32.4, $3,900	4, 32.4, $4,375 5, 40, $4,900	6, 40, $5,150
Palmer	Palmer-Meyer Motor Car Co., St. Louis, Mo.		1, 22.5, $1,560	2, 27.2, $2,295			
Peerless	Peerless Motor Car Co., Cleveland, Ohio				3, 32.4, $4,000	4, 32.4, $4,150 5, 32.4, $4,700	6, 32.4, $5,200
Pierce-Arrow	Pierce-Arrow Motor Car Co., Buffalo, N. Y.			2, 25.6, $3,750		5, 38, $5,500	
Pullmore	Pullmore Motor Truck Co., Pittsburgh, Pa.				3, 32.4, $3,650		
Rainier	Rainier Motor Corp., Flushing, N. Y.	½, 22, $995	1, 22, $1,340				
Reo	Reo Motor Car Co., Lansing, Mich.	¾, 27.2, $1,175		2, 27.2, $1,800			
Republic	Republic Motor Truck Co., Alma, Mich.	¾, 16.9, $895	1, 19.6, $1,195 1½, 22.5, $1,450	2, 27.2, $1,885	3½, 28.9, $2,750	5, 32.4, $4,250	
Rowe	Rowe Motor Mfg. Co., Downingtown, Pa.			2, 32, $2,800 2½, 32, $3,000	3, 40, $3,400	5,48, $4,500	
Royal	Royal Motors Co., Napoleon, Ohio		1, 37, $1,275				
Royal	Royal Motor Truck Co. of New York, New York City		1, 16.8, $1,850 1½, 22.5, $2,100	2, 25.6, $2,500 2½, 28.9, $2,850	3½, 30, $3,600	5, 36.1, $4,500	6, 42, $4,800 7, 44.1, $5,000
Rush	Rush Motor Truck Co., Philadelphia, Pa.	½, 29, $895					
Sandow	Sandow Motor Truck Co., Chicago, Ill.		1, 19.6, $1,485 1½, 19.6, $1,875	2, 27.5, $2,450	3½, 32.4, 3,450		
Sanford	Sanford Motor Truck Co., Syracuse, N. Y.			2½, 27.23, $2,900	3½, 32.4, $3,600	5, 32.4, $4,600	
Schacht	G. A. Schacht Motor Truck Co., Cincinnati, Ohio			2, 28.9, $2,950 2½, 28.9, $3,300	3½, 28.9, $3,600	5, 28.9, $4,700	
Schleicher	Schleicher Motor Vehicle Co., New York City				3, 29, $3,500	5, 40, $4,500	
Selden	Selden Motor Vehicle Co., Rochester, N. Y.	¾, 15.6, $1,075	1, 19.6, $1,550	2, 22.5, $2,350 2, 27.2, $2,550	3½, 32.4, $3,400		
Service	Service Motor Truck Co., Wabash, Ind.		1, —, $1,900 1½, —, $2,550	2, —, $2,750	3½, —, $3,600	5, —, $4,600	
Sheridan	Sheridan Commercial Car Co., Harvey, Ill.	½, 22, $540					
Signal	Signal Motor Truck Co., Detroit, Mich.		1¼, 27.23, $1,875 1½, 27.23, $2,375	2½, 27.23, $2,835		4, 32.4, $3,825 5, 32.4, $4,475	
Standard	Standard Motor Truck Co., Detroit, Mich.			2, 27.2, $2,500	3½, 32.4, $3,200	5, 32.4, $4,000	
Northwestern	Starr Carriage Co., Seattle, Wash.		1½, 30, $2,300	2, 30, $2,600			
Stegeman	Stegeman Motor Car Co., Milwaukee, Wis.			2, 29.4, $2,600	3, 29.4, $3,800	4, 33.8, $3,800 5, 38.4, $4,500	
Sterling	Sterling Motor Truck Co., Milwaukee, Wis.			2½, 35, $2,950	3½, 45, $4,250	5, 52, $5,000	7, 52, $5,500
Stewart	Stewart Motor Corp., Buffalo, N. Y.	¾, 14.4, $845	1, 19.6, $1,390 1½, 22.5, $1,585	2, 32.4, $2,195			
Studebaker	Studebaker Corp. of America, South Bend, Ind.	½, 24.22, $945	1, 24.22, $1,300	Other models, new in 1	918, not ready to anno	unce	
Sullivan	Sullivan Motor Truck Corp., Rochester, N. Y.		1½, 22.5, $2,150	2, 27.75, $2,600			
Superior	Superior Motor Truck Co., Atlanta, Ga.		1, 19.6, $1,500	2, 22.5, $2,000			
Taylor	Taylor Motor Truck Co., Fremont, Ohio		1, 20, $1,750 1½, 23, $2,250	2, 27, $2,900	3½, 32, $3,650	5, 44, $4,600	
New York	Tegetmeier & Reipe Co., New York City		1½, 27.2, $2,200	2, 27.2, $2,600			
Tiffin	Tiffin Wagon Co., Tiffin, Ohio	¾, 19.6, $1,190	1, 19.6, $1,550 1½, 22.5, $1,970	2, 27.2, $2,500 2½, 27.2, $2,700	3½, 32.4, $3,400	5, 33.8, $4,550	6, 33.8, $4,650
Tower	Tower Motor Truck Co., Greenville, Mich.	¾, 32, $1,150	1½, 32, $1,800				
Trabold	Trabold Mfg. Co., Johnstown, Pa.		1, 19.6, apply	2, 29, apply			
Twin City	Twin City Four Wheel Drive Co., St. Paul, Minn.				3½, 52, $4,250		
Union	Union Motor Truck Co., Bay City, Mich.			2½, 25.6, $2,075			
Allfour	United Four Wheel Drive Truck Corp., Chicago, Ill.				3, 34, $4,500		
Lamson	United Four Wheel Driver Truck Corp., Chicago, Ill.		1½, 25.6, $1,850	2½, 25.6, $2,450	3½, 36.2, $3,150	5, 41.6, $4,150	
United	United Motors Co., Grand Rapids, Mich.			2, 40, $2,350	3¼, 50, $3,150	4, 50, $3,450 5, 62, $4,250	
U. S.	United States Motor Truck Co., Cincinnati, Ohio			2½, 27.2, $2,650	3½, 32.4, $3,350	5, 36.4, $4,550	
Universal	Universal Service Co., Detroit, Mich.		1½, 22.5, apply	2, 25.6, apply	3, 25.6, apply		
Velie	Velie Motors Corp., Moline, Ill.		1½, 35, $2,750		3½, 45, $3,600		
Viall	Viall Motor Car Co., Chicago, Ill.			2, 18, $2,200			
Vim	Vim Motor Truck Co., Philadelphia, Pa.	½, 19, $765	1½, 36, $2,750	2½, 46, $3,550			
Walter	Walter Motor Truck Co., New York City					5, 45, $5,000	6, 50, $5,200 7½, 50, $5,300
Standard	Warren Motor Truck Co., Warren, Ohio			2½, 45, $2,600			
Western	Western Truck Mfg. Co., Chicago, Ill.						7, 36.5, $5,250
White	White Co., Cleveland, Ohio	¾, 22.5, $2,300	1½, 22.5, $3,300		3, 22.5, $4,100	5, 29, $5,000	
White Hickory	White Hickory Wagon Mfg. Co., Atlanta, Ga.		1½, 22.5, $2,200				
Wichita	Wichita Falls Motor Co., Wichita Falls, Texas		1, 19.6, $1,750 1½, 19.6, $,1950	2, 19.6, $2,250 2½, 22.5, $2,500	3½, 32.4, $3,450	5, 32.4, $4,000	
Wilcox	H. E. Wilcox Motor Co., Minneapolis, Minn.		1, 32, apply 1½, 40, apply	2, 40, apply	3½, 40, apply	5, 50, apply	
Overland	Willys-Overland, Inc., Toledo, Ohio	¾, 32, $785 ¾, 35, $930					
Wilson	J. C. Wilson Co., Detroit, Mich.		1, 25, $1,650	2, 35, 2,550	3½, 40, $3,250	5, 40, apply	
Winther	Winther Motor Truck Co., Winthrop Harbor, Ill.			2, 25.6, $3,000	3, 25.6, $3,600	4, 29, $4,200 5, 36.1, $4,800	6, 42, $5,500
Witt-Will	Witt-Will Co., Inc., Washington, D. C.			2, 35, $2,500			
W S	W S Truck Co., Birmingham, Mich.				3½, 32.4, apply		

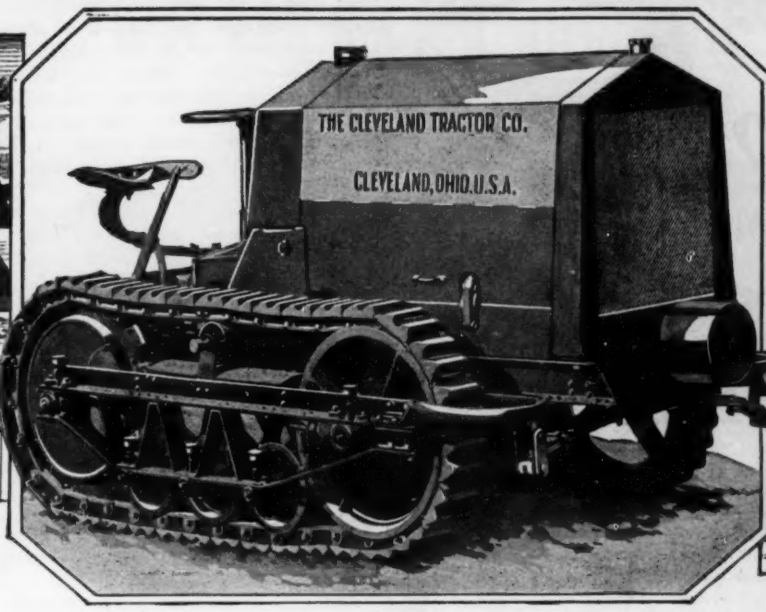
Electric Commercial Vehicles for 1918

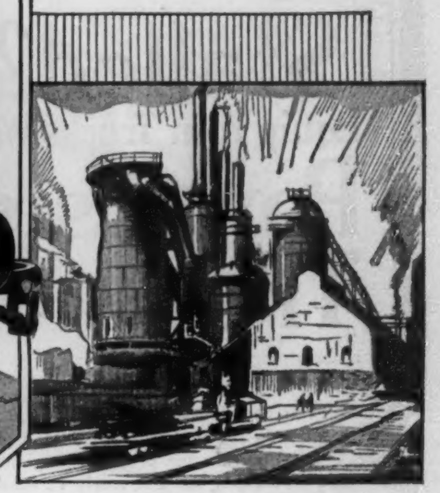
Name of Vehicle	Name and Address of Manufacturer	Tons Capacity and Price: Under 1 Ton	1-1½ Tons	2-2½ Tons	3-3½ Tons	4-5 Tons	Over 5 Tons
Atlantic	Atlantic Electric Vehicle Co., Newark, N. J.		1, $2,300-$3,025	2, $2,850-$3,800	3½, $3,425-$4,700	5, $3,900-$5,434	6, $5,050-$5,800
C. T.	Commercial Truck Co. of America, Philadelphia, Pa.	½, $2,170-$2,870	1, $2,710-$3,430	2, $3,275-$4,275	3½, $4,510-$5,750	5, $5,090-$6,565	
Couple Gear	Couple Gear Freight Wheel Co., Grand Rapids, Mich.				3½, $4,500	5, $5,000	7, $4,600-$5,600
G. V.	General Vehicle Co., Long Island City, N. Y.	½, $1,360	1, $2,100	2, $2,600	3½, $3,250	5, $3,700	
Ehrlich	Lammert & Mann Co., Chicago, Ill.			2, apply; other sizes to	be announced later		
Lansden	Lansden Co., Inc., Brooklyn, N. Y.	½, apply ½, apply ¾, apply	1, apply	2, apply	3½, apply	5, apply	6, apply
Milburn	Milburn Wagon Co., Toledo, Ohio	¾, apply					
Walker	Walker Vehicle Co., Chicago, Ill.	½, $1,600	1, $1,900	2, $2,300	3, $2,650	4, $3,100 5, $3,300	
Ward	Ward Motor Vehicle Co., Mt. Vernon, N. Y.	½, apply ½, apply	1, apply	2, apply	3½, apply	5, apply	
Waverley	Waverley Co., Indianapolis, Ind.	½, $900 ½, $1,100	1, $1,200				

Steam Driven Cars and Trucks

Name of Car	Name and Address of Manufacturer	Bore and Stroke	Fuel	Heating Surface	Type of Vehicle	Price
Doble	Doble-Detroit Steam Motors Co., Detroit, Mich.	4 x 5	Kerosene	150 sq. ft.	Passenger; temporaril	y withdrawn
Doble	Doble-Detroit Steam Motors Co., Detroit, Mich.	4 x 4	Kerosene		Truck	Apply
Stanley	Stanley Motor Carriage Co., Newton, Mass.	4½ x 6½	Gasoline or Kerosene	104 sq. ft.	3p. Roadster 5p. Touring 7p. Touring	$2,200 $2,200 $2,300
Stanley	Stanley Motor Carriage Co., Newton, Mass.	4½ x 6½ 4½ x 6½	Gasolene or Kerosene Gasolene or Kerosene	104 sq. ft. 158 sq. ft.	¾-ton Truck 1¼-ton Truck	Apply Apply
Steamotor	Steamotor Truck Co., Chicago, Ill.	Apply for engine detai	ls		2-ton Truck 3½-ton Truck	$3,350 $4,250

Cleveland Tractor





In Every Country of the World Farms and Factories Need This Tractor

STERN necessity demands the use of advanced methods. Patriotism urges them.

Practically every line of industry is suffering from the dearth of labor and the rising cost of doing business. America looks to farm and factory alike for increased production.

In this emergency, progressive Americans are effectively using the Cleveland Tractor to counteract their heavy handicaps.

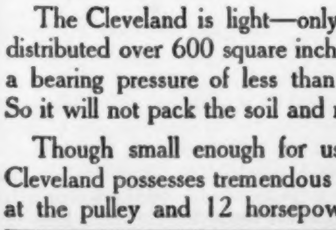
Farmers find that the Cleveland Tractor does their work better, faster and at much lower cost than they can do it with horses and men. This means increased yields with less labor and at lower cost.

The Cleveland crawls on its own tracks and can go practically anywhere—over ditches and gullies—even through the sand, gumbo, and rice swamps of the South.

It hauls two 14-inch bottoms, and with them it *plows up to 3½ miles an hour*—actually 8 to 10 acres a day. That is more than three good 3-horse teams and three men can possibly do in the same length of time.

The Cleveland is light—only 2750 pounds. This weight is distributed over 600 square inches of continuous traction surface—a bearing pressure of less than five pounds to the square inch. So it will not pack the soil and rob it of its fertility.

Though small enough for use among young fruit trees, the Cleveland possesses tremendous power. It gives 20 horsepower at the pulley and 12 horsepower at the draw-bar—ample for the hauling and stationary jobs found on any farm.



The same advantages, so useful on the farm, are proving invaluable to leaders in many widely varied lines of industry.

Factory owners are using the Cleveland with great profit for moving materials, both in the buildings and yards of their plants. The small size of the machine—it is only 52 inches high by 50 inches wide—96 inches long—enables it to pass easily through narrow aisles and ordinary factory doors, and to turn around in a 12 ft. circle.

By virtue of its crawler type construction it does not injure the surface over which it passes.

In many up-to-date foundries the Cleveland has supplanted man-power at the task of moving castings to the machine shop or rumbler. *It hauls as high as 10 tons in transfer buggy work.* That is about three times the capacity of the small trucks frequently used for inside hauling.

Contractors have found that on surface grading jobs, the Cleveland works at the rate of 100 cubic yards on hauls as high as 1500 feet—3 or 4 times the work of the best draft teams. And it handles two dump wagons at twice the speed of teams at any kind of hauling.

In lumber yards, and logging camps, on railroad platforms, at freight terminals and docks—in scores of places and at scores of tasks where heavy work must be performed at light cost—the big, important exclusive Cleveland advantages will quickly pay for themselves.

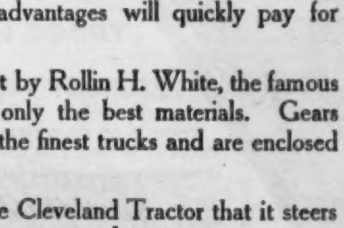
The Cleveland Tractor is built by Rollin H. White, the famous motor truck engineer. He uses only the best materials. Gears are identical with those found in the finest trucks and are enclosed in dirt-proof, dust-proof cases.

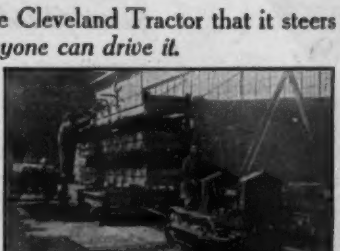
Mr. White has so designed the Cleveland Tractor that it steers by the power of its engine. *Anyone can drive it.*

The Cleveland Tractor is a time saver—a labor saver—a money maker. It is a business investment pure and simple.

If you are a farmer, a factory head, a contractor or a wide-awake business man engaged in any one of a hundred lines the Cleveland will pay you big dividends.

Write to us today for complete particulars. Address Dept. CM, or use the coupon.





THE CLEVELAND TRACTOR COMPANY, Cleveland, Ohio

THE CLEVELAND TRACTOR COMPANY, Dept. CM, Cleveland, Ohio

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Standard Steel Cargo Ships for the War Zone

(Concluded from page 8)

facilities, the progress to completion will be greatly accelerated and will proceed with a clocklike regularity; so that the momentum thus given will produce a finished ship in an incredibly short time. Never before has the building of ships been attempted on such a vast scale. The experience the company has gained in the past in reproducing submarines and submarine chasers in large quantities in quick time will count heavily in the speed of production and completion of the ships that are now under way.

By the courtesy of the Committee on Public Information, we are enabled to present the accompanying wash drawing showing the general appearance of the ships which are being built at this shipyard. Our artist has given an impressive reproduction of these vessels as they will appear when in service; and we think that the readers of the Scientific American will agree that although this is a "fabricated" ship with over three-quarters of the work upon it done many hundreds of miles inland, she is, for a freighter, a decidedly good looking craft.

Her length overall is 335 feet; beam 46 feet; depth 28 feet, 6 inches; draught 22 feet, 6 inches.

Although her engine power is rather small, namely 1,600 horse-power, it is very much up-to-date — the plant consisting of turbine engines which drive the propeller shaft through a 40 to 1 reduction gear; and this means that since the screw revolutions are 90 per minute the turbine will run at 3,600 r.p.m. The speed will be about eleven knots per hour. A "fabricated" ship is one which is built from standard shapes, which, after they come from the mill, require no shaping or bending in the shops but can be cut and punched or drilled and shipped direct to the assembly yard, in pretty much the same way as the members of a bridge are prepared and shipped to a river crossing. Practically the only bending and shaping which will be needed will be that for the framing and plating at the bow and stern and bilges, which amounts to about twenty per cent of the total weight of steel handled.

The material will be shipped from the mills and shops direct to the shipbuilding plant on Newark Bay, New York Harbor, and here it will be erected on the 28 building ways of this plant, which will have been completed within three months from the day work was commenced. When the plant is in full swing, it is expected that each ship will be launched in a few months from the laying of the keel, and, as soon as a slip is vacated the construction of a new vessel will start immediately.

It will be noticed that the customary two masts, forward and aft, of the freighter are dispensed with, and their place is taken by a single pole mast which rises from the superstructure amidships, and serves to carry the aerial. The ship has four hatches and two derricks, one forward and one aft of the bridge. When passing through the war zone, the derrick masts, which are hinged, will be laid upon deck, and the absence of masts coupled with the camouflaging of the hull, smokestack, bridge, etc., will render these ships very difficult for a submarine to pick up across any considerable stretch of sea. They will mount two guns, one on the forecastle and one on the poop. The officers' accommodations are in the superstructure amidships, and the crew will be berthed in the forecastle and beneath the poop deck.

With several such yards as this, completed or near completion, on our coasts, the question of setting afloat the steel tonnage which the Shipping Board has set as its aim, becomes more than anything else a question of securing the necessary amount of labor. There are hundreds of thousands of men who are at present engaged in occupations which render them well fitted, with a little instruction and experience, to assist the country in this great shipbuilding enterprise. The pay is extremely good and there is the prospect of a long period of service. As a matter of fact there is no field in which labor can render such immediate and helpful service in winning the war as in that of helping to build the vast fleet which is necessary, not only to carry our armies to France, but to maintain them with food, clothing, shells, guns and powder after they get there.

Development of the Pneumatic Tire

(Concluded from page 10)

an annular tubular tire, an airtight lining being previously provided. A single tube tire was thus formed and was fitted to an ordinary crescent-shaped rim, to which it was held by cement. The Palmer tire was originally used as a path racing tire, but gradually the principle was applied to other tires. Although the basis of much litigation, in the main the Palmer patents were sustained.

Automobile development has been consistently accompanied by tire development. Step by step the pneumatic tire has been improved until today its state of perfection is quite up to that of the motor car, to which it is so closely allied. Of late the tire fabric has been somewhat altered, for it is found that heavy cords give greater wear than woven goods. The truth is that the manufacture of the practical commercial tires jumped from the 1½-inch bicycle tire to the 4½-inch automobile tire in a year or two, and it remained there until a short while ago. Its limit seemed to be the resistance of close-woven fabric to taking the form of a doughnut and standing the flexing and traction of heavier loads, and greater stretching and crimping given it in the larger sizes. The progress of tire design during the past two years has shown that this limit no longer stands if laminated cords without cross weave are used instead of woven fabric. These cords take the strain without undue fatigue and now we see our way clear to make 12-inch tires just as readily as 4½-inch tires.

So the development of the pneumatic tire culminates in the cord tire of such size and capacity as make it suitable for use on the heaviest of motor-driven vehicles. At this very moment pneumatic tires are being employed on huge motor trucks, which, with their 12-inch tires, are maintaining regular transportation service between distant cities and in this manner relieving the war-time congestion of our railroads. What the pneumatic tire has done for the passenger car it seems in a fair way toward repeating in the case of the motor truck: the lumbering motor truck with its solid rubber wheels is soon to be replaced by an easy riding, silent and swift vehicle.

No better proof of the magnitude of the pneumatic tire industry could be offered than the fact that in 1917 some 18,000,000 tires were sold, which, at an average cost of $25, totaled $450,000,000.

Keeping the Cooling System Hot

(Continued from page 11)

the succeeding level stretch or hill climb. The principle of the thermostat has been applied to the operation of these shutters, so that they may be automatically controlled. The thermostat in this instance is installed in the hose connection between the top of the engine and the radiator and is attached by means of suitable levers to the rods actuating the series of shutters.

The system regulating the flow of air through the cooling surface of the radiator is exceedingly efficient and satisfactory, but it is evident that each time the water is allowed to cool, the greater mass must be heated before the system can attain its most effective temperature.

The third system of engine temperature control is an interesting variation of the first type mentioned. A thermostat placed in the circulation of jacket water is used to control the flow of water through the radiator, but there is no direct connection between the water jacket and radiator. In other words, there are two distinct cooling circulating systems, one consisting of the water jackets and pipes leading to a coil or cooler placed in the top of the radiator, while the other comprises merely the radiator with its connections for circulating the water through the air-exposed cells. It will thus be seen that the radiator water is used only to cool the engine water

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Keeping the Cooling System Hot

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which the thermostat may allow to pass to the cooler. The temperature of the radiator will affect the heat of the jackets only in so far as the thermostat allows the water to pass to the cooler emersed in the radiator. In this system it is necessary to heat only the minimum amount of water in order to attain the most efficient engine temperature. Alcohol, or other easily evaporated, non-freezing solutions, may be used in the radiator, because this water need seldom be brought above 120 or 130 degrees, regardless of the temperature at which it is desired to keep the water surrounding the engine cylinders. The portion of the system comprising the engine jackets and the cooler, may be entirely enclosed and provided with a vent or safety valve set for higher pressures than may be withstood by the average radiator. This would enable alcohol to be used in connection with the jacket cooling water also, with no fear of loss from evaporation.

The relation between the conservation of heat in an internal combustion engine and the conservation of fuel is so direct that the motorist who keeps his engine operated at the proper temperature is as effectively serving his country as is the driver who, although patriotically remembering to shut off his engine each time the car is brought to a stop, nevertheless allows the temperature of the cooling water to drop so rapidly that as much gasoline is used when again starting the cold engine, as would be the case where he to allow the engine to run idle for a half hour or so at the curb.

The Nerves of a Soldier

(Concluded from page 14)

frank recognition of mental and nervous diseases and a sane and humane endeavor to cure them in their early stages. In all other branches of medicine facilities for dealing with disease in its initial stages are recognized as indispensable, but a person in the first stages of mental breakdown, unless wealthy enough to procure the services of a specialist, must wait, before he can secure trained observation and treatment, till his disorder reaches the point where it necessitates removal to an institution. The success which has attended the treatment in special military hospitals of nervous disorders among soldiers must react helpfully upon the treatment of neuroses in civil life; and at the conclusion of the war we will undoubtedly possess a mechanism of diagnosis and treatment such as has never existed before.

The new service will save us the expense of training, equipping, and sending to France a great number of incompetent soldiers, it will keep many of these men at home in callings where they are efficient, and it will save us a very material addition to the pension roll. But its usefulness will not cease with this. Each division that goes abroad will be accompanied by a unit made up of psychiatrists, neurologists and psychologists, with a personnel of assistants and nurses. This unit will continue the sifting out of the men who do not show their psychopathic tendencies until put under the strain of actual service; and more important than this, it will provide the trained attention necessary for recovery from the mental and nervous disorders engendered by front fighting.

These disorders, which are revolutionizing the type of hospital and the kind of medical service required at the front, are of a curious character. War neuroses are the result of unconscious effort to escape from an intolerable situation in real life to a tolerable one in the life provided by the neurosis. The appeal for reliefis expressed, not in words, but in physical terms that affect the situation itself, at least in its relation to the individual. The soldier who can no longer look at horrible sights becomes blind. Functional deafness is an automatic refusal to bear longer the din of continuous explosion. Hysterical paralysis is a refusal to stand up and go. Hysterical anesthesia is better as an offset against wounds or bayonet jabs than any amount of body covering.

Military authorities early recognized that such cases would not be looked after in general military hospitals, so special hospitals have been established by both France and England, and equipped with sedative baths, douches, and other features which experience has suggested. The patient is given cheerful surroundings and every effort is made to banish the memory of the situation which marked the genesis of his trouble, and to restore his confidence in himself and in the world.

Our army medical service is keenly alive to the situation. A plan is being perfected whereby the disabled soldier will be cared for from the time of onset of neurotic symptoms until it is possible to return him to duty or discharge him into the civilian ranks. This includes base and divisional hospitals, convalescent camps, and the attention of trained neurologists and psychiatrists at stations even nearer the front, as well as facilities in this country for further treatment of the patients who do not recover in France and are invalided to the United States.

But the relative values of prevention and cure are popularly reputed to be as sixteen to one, so the first endeavor of this service abroad will be to work for conditions that will minimize war strain and tend to keep the soldier's point of view sane and normal. Emphasis will be laid upon shortening the period in the trenches, with frequent intervals for wholesome recreation. All sports will be encouraged, and something will be found to appeal to the taste of every man. During the periods when the men are out of the trenches every effort will be subordinated to the one big aim of providing complete relaxation and a let down from the unwholesome tension of firing-line duty. Only in this way is it believed to be possible to preserve the collective sanity of the modern soldier.

Automobile Development During 1918

(Continued from page 16)

fashion, the fuel consumption is excessive in proportion to the power developed because it is not properly gasified and raw fuel is taken into the combustion chamber. This excess is not all burned during the explosion but a certain amount of it will leak by even the most tightly fitted piston rings and as the oil collects in the crank case and oil sump of the engine, the fuel oil will dilute the lubricating oil, and as it reduces the viscosity the clearances in the bearings will not be properly filled with a cushion of lubricant, and mechanical depreciation will be more rapid. It has been found that with the ordinary design of engine this leakage of fuel may be so rapid as to require the clearing out of the oil sump once a week and the supplying of entirely new and fresh lubricant. As about $3.00 worth of engine oil is required to replace that drawn out in the average truck, it will be evident that this oil depreciation, due to condensation of heavy fuel, is an item of some moment. When the viscosity of the oil is reduced the engine will wear out faster and experts who have had an opportunity to note the amount of depreciation say that the life of the engine may be reduced as much as 33⅓ per cent because of the diminished efficiency of the lubricant. Another difficulty which arises in cold weather is difficulty in starting the engine if the fuel does not evaporate readily, and also if the evaporation is not thorough it will require more low grade fuel to produce a given amount of power even though it has a theoretically higher thermal value and should give as much, if not more power if properly utilized.

Types of carburetors have been developed in which the fuel is broken up into as fine particles as possible in the mixing chamber and sufficient heat is provided to assure vaporization even though the gasifying of the fuel is not fully completed in the carburetor. Long intake manifolds are not practical so that the newer engines have short manifolds and the carburetor is carried as near the cylinder block as considerations of design permit. In some cases the intake passages may be cored into the cylinder block casting and be thoroughly water-jacketed. In such designs the carburetor is bolted directly to

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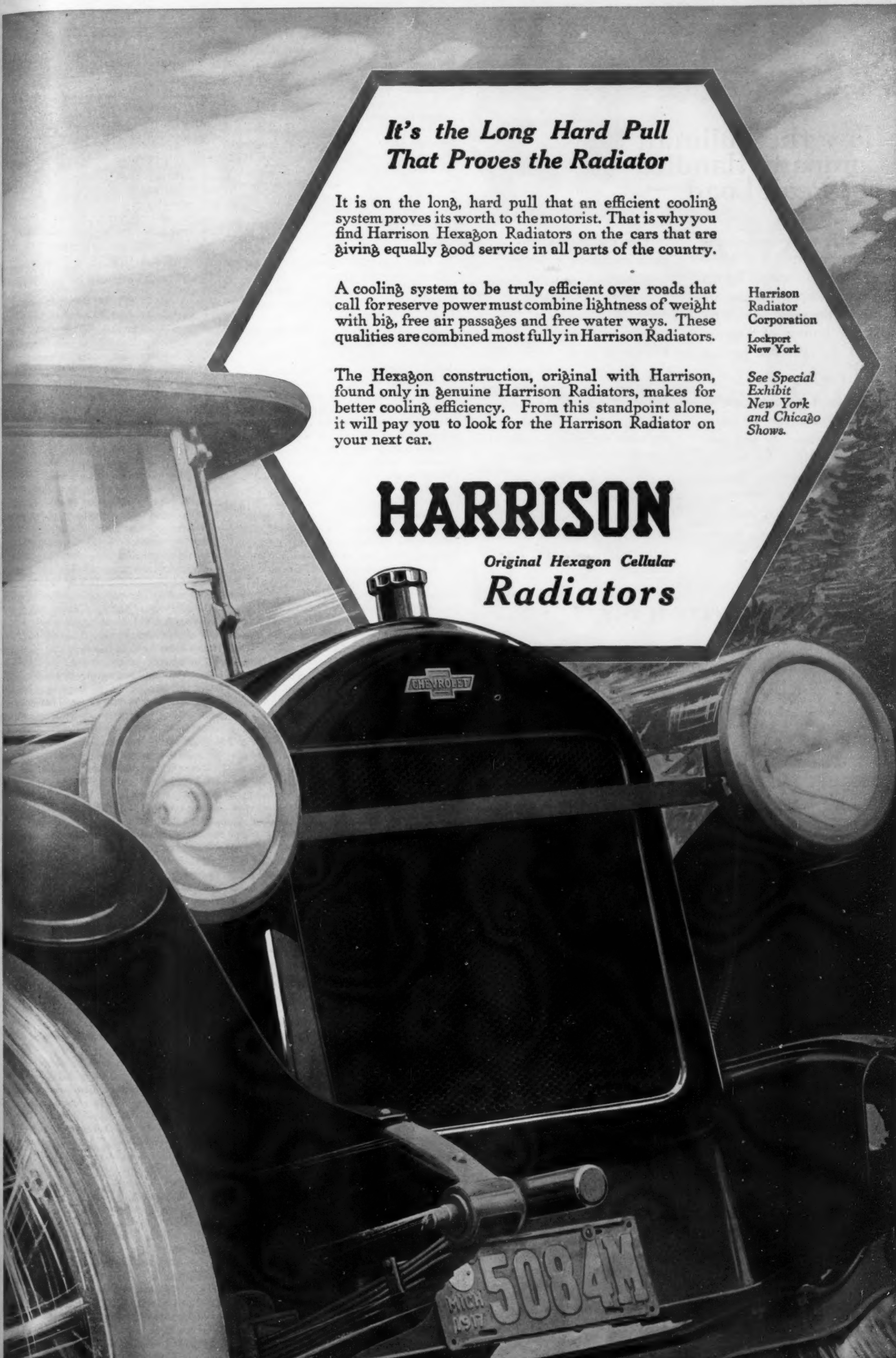
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Automobile Development During 1918

(Concluded from page 48)

the cylinder. The combined inlet and exhaust manifold, in which the exhaust gases are depended on to heat the mixture, is another promising solution of the carburetion problem, providing that the liquid fuel used will vaporize fast enough to permit the engine to be started in cold weather without the use of an auxiliary fuel supply such as is needed with most of the kerosene carburetors. In the combined manifold or in those where the intake manifold is in actual metallic contact with the exhaust member, an effort is made to provide a very hot spot in the manifold where the unvaporized particles of fuel will strike and be vaporized on the way into the cylinder. The gas is lighter than the globules of liquid and hence only the drops of fuel impinging on the hot spot will be positively vaporized or boiled off into gas.

An exhaust stove is provided also though this in itself is not sufficient. There is always the danger that the primary air will be overheated, which means that the charge of air drawn into the cylinders will be lessened as the temperature increases. This is remedied by using a cold air shutter which can be opened to admit a certain proportion of cold air as the throttle is opened and as the exhaust pipes become heated. Another device that is being fitted to all types of vehicles is thermostatic control to regulate the temperature of the cooling water in the radiator. This was one of the developments of the past season and it has given such good results that more makers are using it at the present time. Several kerosene carburetors have been produced, some operating on the partial combustion system, in which a certain proportion of the fuel is burned in order to vaporize and form a gas-fog of the remainder. While this type is less efficient than the more conventional forms it has the advantage of being able to start the engine without using any auxiliary fuel. The other types of kerosene carburetors depend on heating both the liquid fuel and the mixture before it is applied to the engine and in some cases using an injection device to supply water to the mixture.

Practically no change has been noted in pleasure car design except in the minor refinements in body construction. The closed type cars that can be converted into open cars during good weather are becoming more and more popular. As the bulk of the motoring population cannot maintain both open and closed cars, the permanent top, drop-sash closed bodies are therefore deservedly popular. The close-coupled, four-passenger or clubster body is still making gains and will be offered by practically all makers as an option during the coming season.

How to Assist Military Aviators who have Made Forced Landings

WITH the development of our aerial program there are bound to be more and more airmen flying over the country, and from time to time an airman may be forced to land in a spot far from the nearest aviation field. In such cases civilians can render important aid if the following set of instructions adopted by the Aircraft Board and approved by the Secretary of War, are followed:

If a military aviator is forced, through motor trouble, to make a landing, the public is cautioned, as soon as it is ascertained that the aviator is not injured, to keep clear of the machine, not to touch the control wires, instruments, etc., as an untrained person may so disarrange these as to cause a serious accident when the aviator starts to leave the filed.

If there is a military post or encampment near the scene of a forced landing, a guard will at once be sent to the spot. If no military organization is avialable, the police of the nearest town are requested to provide a guard at once for the machine. This will enable the aviator to leave his machine to telephone to his proper headquarters, secure supplies for repairs, etc.

In case the machine is wrecked in landing, or has fallen out of control, the military authorities, if present, otherwise the police will prevent the public from approaching the wreck. It is indispensable, in order that the cause of the accident may be determined, to leave the machine in the same situation as found after its fall, after having done as much moving of the parts as it is necessary to free the aviator.

All railroads and steamship companies are requested to instruct their employees to render all the assistance possible to aviators who may be forced to land in out-of-the-way and remote places, or in the water, and to stop any and all trains or steamships to pick up the aviator, and to stop again for the purpose of letting him down at any station where his duties require his presence without regard to whether such place is a regular stop or port of call.

The Gasoline Horse in The West

Continued from page 17)

types, it is evident that the wheeled tractor just at present has the better of the argument in point of numbers sold and used.

The tractors now available range from the giant track-layer of 75 horse-power, down to the little 6 horse-power, ton-and-a-half machine. The ranchers of the Imperial Valley, however, found the most satisfactory all-round type to be the sort developing about 10 horse-power on the drawbar—either wheeled or track-layer. This machine will pull a three-gang plough and will break up eight acres in a ten-hour day. One rancher, quoted as showing the possibilities in the hands of the average man, ploughed 650 acres in 65 days, doing all the work himself.

The comparison of horse-power on the drawbar is, of course, merely the work the machine will do on an all-day pull. Any half-good ten-horse team can drag around by its tail a machine with 10 horse-power on the drawbar, but in a day's full grind the machine will do the most work. The cost of operation of a machine of this type ranges from \$3 to \$4 per day.

The tractors of the present day are becoming less and less cranky in their tastes. Most of the machines demonstrated at the Los Angeles show burned distillate or kerosene. One of them was working on a grade of fuel so crude that it cost but 6½ cents per gallon. This is important, because the cost of distillate and kerosene will never approach nearer than 50 per cent of that of gasoline, while if war demands for gasoline for planes and motor cars exceed our supply, then gasoline will jump to an inflated value, possibly four times as much as the always plentiful distillate or kerosene.

The hot climate of the southwest, particularly of some California districts, makes adequate cooling of the engine of the crawling, hard-working machine a problem, but it was apparently solved by most of those made this year. It will be remembered that the engine is working always under a heavy load, while there is no rapidly-moving radiator to get the advantage of a constantly renewed air.

Only the person who has climbed around though the awful dust clouds of a tractor show can appreciate that the carburetor problems of the motor car are not a circumstance to those of the tractor. With the dust swirling in choking clouds about the machine in the light, baked soils of the southwest, the ordinary carburetor would speedily pass to the engine enough soil to form a beautiful abrasive with the oil and carbon. The successful machines used various screening devices, several of them passing the intake air through complete water-seals like the familiar Turkish hookah.

No tractor show would be complete without its share of converters. Year by year the devices increase for harnessing up to the plough the familiar little black automobile. The sturdiness and reliability of the little 20-horse-power motor, the low cost of the car, and its great vogue all make it a bright mark for the man who can figure out ways to hitch it to the farm tool. A dozen of them were at the Los Angeles show, the most efficient one guaranteed to plough six acres of ordinary soil per day, with a fuel consumption of 1½ gallons per acre.

The simplest modification was merely taking off the rear wheels and substituting therefor wide-tread steel tractor wheels with the familiar "grousers." Steel-tired wheels were substituted for the front wheels. To get the requisite gear reduction for the power and low rate of speed of this tractor, the low speed gear of the car was used. The scheme is not the best possible one, because of the comparative inefficiency of the low speed of any planetary transmission and the tendency to heat the motor.

Possibly more efficient was the scheme, used by various makes of tractor attachments, of bolting on a heavy supplementary axle to the chassis at the rear, either in front of the ordinary axle or behind, as the user desired the wheel base. This heavy axle carried the tractor wheels, with tread up to 14 inches in width, while the rear axle of the car was used merely as a jack-shaft to drive the wheels. The power was transmitted by a little pinion at either end of the jack-shaft meshing with teeth cut on inside of the tractor wheel. The most workmanlike device cased in the entire wheel, with the drive pinion and gear, enabling proper lubrication and preventing the intrusion of the dirt that was so noticeable in the types with the drive pinions and gearing exposed. Such a tractor worked quite satisfactorily for all jobs where a 4-horse-power pull was sufficient. A point in favor of these convertible tractors was the fact that in various lengths of time, from thirty minutes to a couple of hours, the car could be reconverted into the ordinary road automobile, and used for hauling to market, errands, etc. The ordinary tractor, possibly because of its snail-like progress, is used but little on the road, its work in this respect being estimated as only four per cent of its total activity.

The drawback of the tractor is the necessity occasionally for more expert mechanical treatment than the rough-and-ready farmer can at present give it. Here arises the need for the tractor doctor, some young chap who will take up tractor construction and repair and be available in his district just as the veterinary is at present. The ideal handling of the tractor is to make it do the work of several adjoining farms, being sent from home as soon as its own home work is done. The tractor doctor can do much to make it stand up and give service in the hands of the inexpert, rough-handed gentlemen who will usually run it.

The enemy of the tractor and the tractor movement is the too-common type of farmer who leaves his farm tools where he finishes with them or out in the rain in the barnyard. The tractor needs more attention than does the horse, but it need not necessarily take more time. It must be gone over in the morning, oiled systematically where the book says to oil it by hand, its oil tanks filled, its grease cups turned and its water and gas tanks replenished, and inspected for loose or worn parts. Systematized this need not take the time required to feed and harness Dobbin. The man who has watched the neglect and yet the faithful service of the small automobile, which in some hands is oiled only where and when it squeaks, will have faith that the tractor will work with little trouble when given half-way systematic and intelligent treatment.

The tractor, according to our own Government reports, will put an increased area of land under cultivation, decrease the number of horses necessary, that now eat up the equivalent of 35,000,000 bushels of food per year, cut ploughing cost about a third, replace hard-to-get farm laborers and make the work more attractive to those still remaining, make the best of the limited time available for such jobs as ploughing or harvesting, and increase the fertility of the land cultivated because of the deeper, more efficient ploughing cultivation. The machine of course costs nothing for upkeep when standing idle, which is not true of the horse.

There are about 50,000 tractors in the hands of American farmers at the present writing, while the total output of 1917 will be not far from 70,000—an illustration

of the enormous increase in popularity of the tractor.

If war, with its demonstration of tractor efficiency in German ploughing of the land of conquered nations, and with its tremendous drain of horses, and men and food for both, lasts another year, the tractor will perforce cease to be an object of curious speculation on the part of the American farmer and will become something dictated by grim necessity.

Looking Forward

(Concluded from page 18)

in use in the United States. This estimate is based on an average life of eight years. In addition to the prospective increased demand at home after the war, there is a big potential market throughout the rest of the world. We have already considered special conditions created by the war which will advance motor travel and motor transportation in many other lands.

In this connection a recent compilation made by the Foreign Trade Department of the National Association of Manufacturers of the United States of America is of interest. This shows that were other countries to employ motor vehicles in the same proportion to population as the United States, there would be a market for 56,201,213 automobiles. It is inconceivable that China, for example, would ever reach our ratio, but on the other hand, Australia, Africa and South America should surpass it. Taking into consideration wealth, roads and other important factors, a market is shown outside the United States for 3,617,570 motor vehicles. On account of the war our automobile industry has the opportunity of securing the major part of this business.

What appear to be handicaps to a continued rapid growth in the use of motor vehicles are not serious. Take the threatened shortage in gasoline for example. Higher prices for this fuel may come but the automobile has progressed steadily in countries where the prices have been from three to six times higher than in the United States. Higher prices will serve to stimulate the production of gasoline, while improved methods of distillation will increase the amount secured from a given volume of the crude oil. Furthermore, many petroleum authorities decry the threatened gasoline shortage.

Besides, carburetors are now offered that make possible the use of kerosene as a motor-vehicle fuel; and alcohol is available in combination with gasoline or as a substitute. With the prohibition threat, we may expect our distilleries to seek a way out in the manufacture of alcohol in large quantities from sawdust and other waste. So that the fuel situation really furnishes small ground for apprehension.

Even in the United States, despite its ownership of 77 per cent of all the automobiles in the world, road conditions have been a real handicap. Less than ten per cent of our total road mileage is classed as "improved." However, we may anticipate a growing appreciation of the utilitarian value of the motor vehicle in this country which will give marked impetus to road improvement. Federal aid for this purpose is already an accomplished fact. And when we consider that the railways, particularly the transcontinental lines, have more than repaid the material help given them by State and Federal Governments, and that aid of water transportation through dredging of harbors and rivers alone has cost the Federal Government nearly a billion dollars, we may fairly look for an early correction of the point of view which has heretofore excluded the user of our common roads from such benefits. With this same appreciation of its utilitarian value will come a correction in the improper classification of the motor vehicle as a luxury and a non-essential, with a cessation of unjust legislation and taxation.

According to a time-honored belief of the French, transportation is civilization. The motor vehicle is the great transportation factor and accordingly the great potential civilizing agent of modern times. The Great War has set civilization back many years and the motor vehicle will be a big

factor in helping it to catch up with the progress of time. Pessimism as to the future of that vehicle is unthinkable.

Iowa's Traffic Census and What It Teaches

(Concluded from page 19)

1,394 touring cars before drawing any conclusions on this part; for while a tourist is not compelled by law to travel in a touring car any more than a road agent is restricted to the use of a roadster, there is a very reasonable probability that he will do his touring in that type of vehicle. We can only reconcile this showing with the facts of farm life by recalling that the farmer's touring car and roadster are, in practice, combination passenger and freight vehicles, in which an extraordinary variety of food supplies, furniture, tools and miscellaneous goods of every description is transported. The same observation is of importance in connection with our first graphic, which shows that there were 16 passenger conveyances of all types for every one freight vehicle. It is clear from close analysis of the report that light delivery wagons, stages, mail-carriers, and similar outfits have been classified as passenger traffic.

Another item of interest to road engineers is the total tonnage figures, which will make it clear whether more traffic passes over a given road than the surface of that road is prepared to support; while a consideration of the heaviest single loads will indicate whether the bridges and culverts are approaching the danger point and might well have a bearing upon the decision of the car manufacturer as to what model he should put out and just how he should build it. Again, the detailed survey of tire sizes and shapes and conditions, if properly made with reference to conditions of usage, will mean much alike to tire makers and to road makers and to the users of tires and roads.

In fact one might well survey these returns for a long time with the assurance that all the juice had not been squeezed out of them. But of all the things which they tell us, nothing is more suggestive than the fact, upon which we have put first emphasis, that of all the traffic over this road, 94 per cent is local within the section of the state which would be called upon to support the road financially. From this showing, it is very clear that to the question, "Do good roads pay the man who pays for them?" there can be but one answer.

Lights That Shine Where They Are Wanted

(Concluded from page 23)

a wide variety of specially formed simple and compound lenses which have been placed over automobile headlights by various manufacturers, we select for display here one which is at once new, novel in principle, and effective in operation.

Since even in the convergent type of reflection the focus through which all rays pass and at which all cross is behind the lens, it follows that if the latter were simply a plain sheet of glass it would always be the rays passing through its lower half that would be thrown downward upon the road. The makers of the lens which we illustrate have argued that the ordinary headlight does not have a sufficiently broad beam to light properly the whole width of the road; so they have made this lower half of their lens consist of two sets of obliquely parallel prisms, as shown in the picture. It is plain enough that the result is to spread this part of the light out in a broad fan over the entire surface of the road and the strip of land at either side.

But it is not enough to have the whole right of way lighted, so that one can see clearly the sudden turn, the sharp ditch or bank, the child about to dash out in front of the car from the shadows in the edge of the woods. We want in addition a concentrated illumination down the center of the roadway, along the narrow track in which the car is traveling. So this manufacturer has reasoned that if the motorist will only refrain from absorbing half his light in a dark segment of his reflector, and will then keep this conserved sheaf of rays entirely separate, instead of mixing it indiscriminately in with the rest

of his light, it will be possible, by proper lens adjustment, to use it for the purpose mentioned. Accordingly this lens contemplates that light be reflected onto its upper half in regular order; and the lens then takes upon itself the office, which would otherwise have to be filled by the reflector, of bending this light down and sending it where it is wanted. Only, instead of spreading the rays out into a widely diffused fan, as the lower half did with its share of the light beam, the upper half, by means of a series of concentric semi-rectangular prisms, takes the rays passing through it and bends them inward and downward to form a dense, brilliant, narrow shaft of light shining down the center of the road.

The combined effect of the two halves of this lens is shown in our two photographs, which it is emphasized have not been retouched in any way. It will be seen that all the light is low, as it should be, reaching barely to the guards of an approaching car.

A more than ordinarily brilliant illumination is given of the central part of the road, where brilliant illumination is wanted, while a diffused light is thrown along the edges, where diffusion is the thing sought. The whole effect is one which must strike any motorist as a consummation devoutedly to be wished.

This is all very well in clear weather; but what when the fog is with us? Every motorist who has driven when his headlight was hurled back into his face from a solid curtain of vapor will recall that not only was vision completely obscured beyond this pall, but that he was not even able to estimate with any degree of accuracy the distance between the car and the visual jumping-off place. What are we to do under such circumstances in the effort to secure visibility and at the same time minimize the hazard.

Perhaps the first thing to do is to borrow procedure from the Germans and inquire of the scientist just what properties of light and matter it is that are at the bottom of our troubles. If we do this, we will be told that the minute particles of vapor and other liquids and solids suspended in the air reflect and refract the light falling upon them, in various ways, until the net result is total confusion. We will also learn that of the many different wave-lengths that go to make up the beam of white light, some are far more susceptible to this action than others. The scientist will doubtless then suggest that if we want relief, we will get it, so far as it is possible to get it, by removing from our beam of light the parts that suffer most from this phenomenon. And he will prescribe, as the means for doing this, glass of various colors, but mostly yellow or green or both in our headlights.

Of course, it goes without saying that fog may be so dense that no kind of light will penetrate it decently. The side of a house is opaque; why not also an opaque wall of water vapor? But any ordinary fog, such as one expects to meet in night and early morning driving in the country, or any ordinary dust-laden city atmosphere will lose the greater part of its terrors if the motorist but has one of the lenses which screen out the light of greatest refractivity, and permit the projection only of such portions of the original beam as will pass through the fog in best order.

Of course, no one of the devices described above will give best service under all circumstances. Some of them, like the offset reflector, are rigid and therefore of greatest value under special circumstances; others, like the filtering lens last described, are designed to give a general stability to the light in some important respect—in this case the stability in question being with reference to atmospheric refraction; still others, like the double-lamp headlight, represent an attempt to meet varying conditions by means of flexibility and adjustability.

All of these undoubtedly have something of good in them; and the motorist who decides which one of them suits the conditions under which he uses his car, and then installs that one, will find that his headlights give him far less concern than ever before.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(14262) E. N. asks: I am writing for a little information concerning about hard rubber. What I want is, what kind of composition is it made from and how may I get the hard rubber in to a liquid form, the kind of hard rubber I want to know about is such as battery jars in the storage battery. Is there any kind of cement that will stop up a leak in a jar? A. Soft rubber and hard rubber are the same material but prepared in different ways Both are heated after having sulfur worked into the rubber gum. About ten or sixteen per cent of sulfur and a temperature of 270 degrees Fahr for four hours will make an elastic rubber while 30 per cent of sulfur, and a temperature of 315 degrees Fahr for two hours will make a rubber hard like ivory. A rubber cement is made by dissolving rubber in bisulphide of carbon. A leak in a hard rubber jar is difficult to repair. The clean rubber may be softened by heating carefully at the two edges to be joined and pressed together till the rubber is hard and cold again. A gutta percha cement may be softened by heat and applied to the crack to fill it and cover it over. You will find valuable and reliable recipes for gutta percha cements and preparing rubber in our Cyclopedia, which we will send for $5.00. We shall be pleased to receive your order for a copy and enclose a descriptive circular from which you can see the wide range of its formulas.

(14263) E. S. says: Your answer to A. C (14245) in the issue of August 18th, regarding sound vibrations, prompts me to ask you for information bearing on the telephone as well as the phonograph. 1. What is a microphone in the transmitter of a telephone. What material is it made of? In what manner is it attached so as to enable the air impulses to effect the electrical circuit and send the vibrations along the line? 2. Just precisely what is the best explanation of how sound is produced through the medium of a record, a needle and a vibrating disk in a phonograph. What material is the vibrating disk made of? What are the best hand-books available on the Telephone and the Phonograph? Book wanted. 3. Does a tuning fork on account of its construction respond more readily to sound producing air-waves than a piece of metal differently constructed? Can a tuning fork magnify these air impulses? What metal or other material is generally considered to be the best transmitter of sound. 4. I have on several occasions listened to a demonstrator who, inside of a show window, communicated with his audience on the side walk through the medium of an announcer, viz.: a megaphone protruded from the upper part of the window and the demonstrator spoke into a receiver at his end. How is this apparatus, or announcer, constructed? Does it make use of an electrical current? Is there a contrivance either in the transmitter, or in the small end of the megaphone which magnifies or augments the sound waves. 5. Is glass a non-conductor of electricity? Is it a sound transmiter? Which material besides rubber, is non-conductive? A. A microphone is a loose contact between pieces of gas carbon or graphite, such as is used in making electric light carbons. It is utilized to enable one to hear very faint sounds. The fact that graphite has this power was discovered independently by Mr. Edison in America and Mr. Hughes in England. It is due to the change of resistance from the change of pressure between the carbons In the telephone transmitter behind the iron plate in the mouthpiece are small balls of graphite. The pressure of the iron plate against these balls is varied by the air pressure from the sound waves of the voice. These balls of graphite are the microphone. Sound is reproduced in a phonograph record, by the point of the tracer following the indentations of the record. We recommend and can supply you with Miller's American Telephone Practice for $4.00. It is a very complete work. Glass transmits sound with the highest velocity, and iron and aluminum are next in the list. A tuning fork is simply a piece of good steel which has a high elasticity and hence vibrates for quite a time after it is bowed or struck. It is a vibrating rod. A tuning fork does not magnify the air impulses: on the contrary it produces vibrations in the air. We have not seen the megaphone used by the announcer as you describe it and have no knowledge of its construction. Glass is a non-conductor of electricity, but a good transmitter of sound. Metals and carbon are good conductors of electricity. Other materials generally are insulators Oils and paraffine are good insulators.

(14264) J. S. J. asks: How does protein show itself or how recognized with food. A. Protein and albumen are now used as names of the same substance. It is a nitrogenous material and is important as a source of tissue in plants and animals. It is a tissue-forming material in distinction from a heat-producing material, although it also is to a degree a heat-producing substance. The white of an egg is albumen in its purest natural state.

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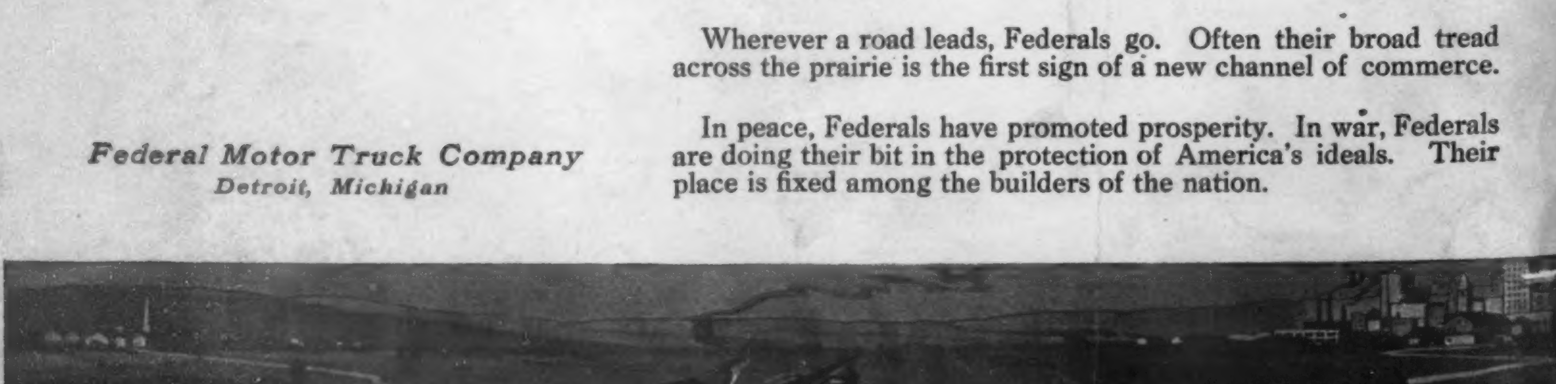

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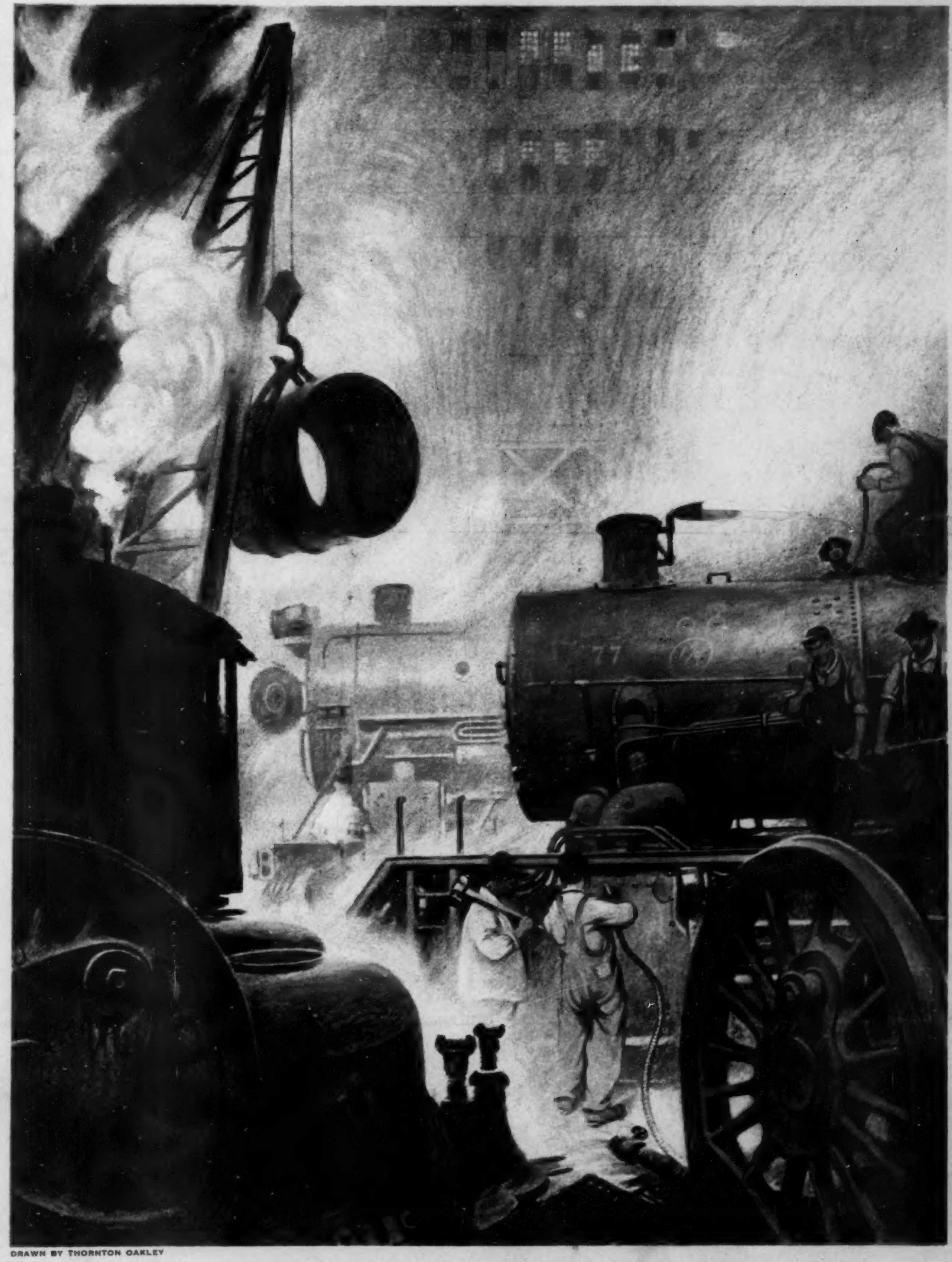

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